



Phase 2 Site Investigation Report NSCC Project, Twycross Zoo

Prepared for Twycross Zoo

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Executive Summary

Client	Twycross Zoo.
Location	Twycross Zoo, Norton Grange, Burton Road, Atherstone CV9 3PX.
Description	The site currently forms part of Twycross Zoo, including the 'Lemur Woods' in the north. A field is present in the south. The two sections are separated by a tree-line, running approximately southwest-northeast. The site slopes from north to south. Twycross Zoo extends to the north and east of the site. Agricultural fields are present to the south and to the west beyond Orton Hill. A farm is located approximately 90m to the southwest of the site.
Development	It is proposed to develop an area in the southwestern section of Twycross Zoo. This will include a new orangutan enclosure in the north of the development area comprising a two-storey steel frame structure, set into a sloping landscape with the potential for some earth retention structures. A cluster of single-storey buildings will be located in the south of the development area including educational spaces, laboratories and short stay accommodation.
Site History	The site comprised rural fields from at least 1885 until 1968. Mapping from 1989 indicated that Twycross Zoo had encroached into the eastern section of the site. The site was indicated to be present in its current layout on mapping from 2022 onward. Surrounding land use was predominantly rural in nature until at least 1968. Orton House farm was located approximately 90m to the southwest of the site and a rectory approximately 150m to the northeast on mapping from at least 1885. Spinney Farm was present from approximately 150m to the west on mapping from 1955. Mapping from 1968 indicated that Twycross Zoo had been constructed and encroached to a distance of approximately 100m to the northeast and east of the site. Mapping from 1989 onwards indicate that the zoo had expanded and encroached into the eastern section of the site. Mapping from 2022 indicated that the zoo had expanded further and encroached onto the site from the north.
Geology	British Geological Survey mapping indicates that the site is underlain by Glaciofluvial Deposits and the Thrussington Member overlying mudstone of the Gunthorpe Member.
Radon	The radon guidance on protective measures for new dwellings indicates that the site is in a 'low' probability radon area where less than 1% of homes are estimated to be at or above the Action Level. Radon gas protection measures are therefore not required in the construction of new dwellings or extensions.
Mining & Ground Stability	The site is not located within an area affected by coal mining. The environmental database report indicates that the site represents a low risk with regard to ground stability issues relating to ground dissolution, shrinking and swelling clays, compressible ground, collapsible ground and landslides.
Flood Risk	According to the Flood Map for Planning, available on the gov.uk website, the site is located within Flood Zone 1, whereby there is less than a 0.1% (1 in 1000) chance of flooding from rivers or the sea occurring each year.

**Environmental
Setting**

The Glaciofluvial Deposits, indicated to be present beneath the site is classified by the Environment Agency (EA) as a Secondary A Aquifer. The Thrussington Member is classified as an Undifferentiated Secondary Aquifer. The underlying Gunthorpe Member is classified as a Secondary B Aquifer. According to EA data, the site is not located within a groundwater Source Protection Zone (SPZ). There are no records of licensed groundwater abstractions located within 500m of the site.

Two unnamed ponds are present to the north, on the wider Twycross Zoo site. A number of land drains are also indicated to be present on agricultural land in the vicinity of the site.

UXO

Zetica Bomb Risk mapping indicates that the site represents a low risk with respect to unexploded ordnance from the Second World War. On this basis, no further risk mitigation measures are considered to be required for intrusive works.

Site Investigations

The first phase of site investigation comprised four rotary drilled boreholes (BH01 to BH04) to depths of approximately 15.00m below ground level (bgl), one window sample borehole (WS05) to a depth of approximately 5.00m bgl and two machine excavated trial pits (SA01 and SA02) to depths of up to 2.00m bgl. Soakaway testing in accordance with BRE Special Digest 365 undertaken in each trial pit.

The second phase of site investigation comprised four window sample boreholes (WS01 to WS04) to depths of approximately 5.00m bgl in the south of the site and four window sample boreholes (WS06 to WS09) to depths of approximately 5.00m bgl in the north between the positions of rotary boreholes (BH01 and BH02) to delineate the area of previously identified loose soils.

Ground Conditions

A limited thickness of Made Ground was recorded from ground surface at each exploratory hole position, ranging from approximately 0.20m to 1.40m. Made Ground was underlain by layers of red-brown, clayey, sandy gravel / gravelly sand and sandy, gravelly clay, considered to be representative of the Glaciofluvial Deposits to depths ranging from approximately 1.00m to 4.20m bgl. Glaciofluvial Deposits were underlain by soft to firm, grey, red and brown, mottled, sandy, gravelly clay, silty sand or gravel considered to be representative of the Thrussington Member, to depths ranging from approximately 4.45m to 7.00m bgl. The Thrussington Member was underlain by weathered red mudstone, considered to be representative of the Gunthorpe Member, to a maximum proven depth of approximately 15.00m bgl.

Contamination

Contaminants of concern were not recorded in soil samples analysed from beneath the site at concentrations in excess of adopted assessment criteria (AC), protective of residential site users. On this basis, contamination beneath the site is not considered to represent a significant risk to future site users.

Significantly elevated concentrations of contaminants of concern, considered to represent a risk to groundwater or surface water resource receptors, were not recorded in soil sampled from beneath the site.

Ground Gas

Based on monitoring undertaken at the site, the ground gas regime corresponds to CIRIA Characteristic Situation 1 (CS1). On this basis, ground gas protection measures would not be required for new structures at the site.

Geotechnical

Based on SPT results, the Glaciofluvial Deposits are likely to provide a suitable bearing stratum for traditional foundations supporting lightly loaded structures, where it is at least medium dense granular or firm cohesive material at foundation bearing depth (assessed to be from approximately 1.50m bgl).

It is understood that larger column loads are anticipated for the Orangutan Enclosure in the northern section of the site. Loose soils were recorded at shallow depth in boreholes BH02, WS06, WS07 and WS09, located in the northern section of the site. Low SPT results in the granular soils were obtained at depths below the recorded groundwater level, indicating that these results were likely associated with 'blowing sands', whereby groundwater uplift pressure locally loosens granular soil during drilling.

On the basis of the above, we would recommend placing foundations above the recorded groundwater level. Ground improvement via vibro stone columns would likely be a suitable method of treating soils to allow higher foundation bearing pressures at shallower depth. Typically, allowable bearing pressures of up to 150kN/m² are achievable following successful treatment via vibro stone columns. However, this should be confirmed following discussions with a specialist contractor. Alternatively, piled foundations could be adopted.

Soakaway Testing

Soil infiltration rate testing was undertaken in accordance with BRE Special Digest 365 in trial pits SA01 and SA02 over depths ranging from approximately 1.00m to 2.00m bgl within the Glaciofluvial Deposits.

In each case, water added to the pits did not drain to 75% of original depth over the 24-hour period of the test. Approximate extrapolated infiltrations rates were 6x10⁻⁷m/s for the test in trial pit SA01 and 9 x 10⁻⁷m/s for the test undertaken in trial pit SA02. These extrapolated calculations assume a linear rate of infiltration and therefore actual infiltration rates may have been lower than this.

The low recorded infiltration rates are considered to be due to the cohesive content of the soils the tests were undertaken within. Deeper boreholes undertaken on site indicate that the cohesive content of soils increased with depth, so it is considered that the permeability of soils would likely decrease with depth.

On the basis of the above, soakaway chambers are considered unlikely to be a suitable method to discharge surface water runoff from the proposed development. However, this should be confirmed by the drainage engineer.

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Borehole Location Plan

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1.0 Introduction

1.1 Background

Clancy Consulting Limited has been instructed by Twycross Zoo to carry out a Phase 2 Site Investigation for a development site located in the southwest of Twycross Zoo, Norton Grange, Burton Road, Atherstone CV9 3PX.

It is proposed to develop the area with a new orangutan enclosure in the north, comprising a two-storey steel frame structure, set into a sloping landscape with the potential for some earth retention structures. A cluster of single-storey buildings will be located in the south of the development area including educational spaces, laboratories and short stay accommodation.

A site location plan and a proposed development plan are provided in Appendix I.

A Phase 1 Preliminary Assessment (report reference 10/2197/001) has previously been undertaken by Clancy Consulting Limited and should be read in conjunction with this report.

1.2 Objectives

The objectives of this investigation are summarised below:

- Undertake intrusive site investigation works to establish the ground conditions across the proposed development area.
- Carry out a geotechnical assessment of the ground conditions and provide preliminary recommendations for foundation design.
- Carry out soil permeability testing to assess the suitability of infiltration drainage to discharge surface water runoff from the proposed development.
- Carry out chemical testing of soil and groundwater samples to determine the contamination status of the site and potential risk posed to human health and environmental receptors.
- Refine the preliminary risk assessment and conceptual site model undertaken as part of the Phase 1 assessment.
- Provide recommendations regarding the requirement for further investigations or remedial works, if required, to satisfy the Local Planning Authority and to inform detailed civil and structural design.

1.3 Limitations of the Study

Clancy Consulting Limited cannot be held responsible for any omissions, misrepresentation, errors or inaccuracies with the supplied third-party report information. The report is written in the context of an agreed scope of work and budget and should not be used in a different context. New information or improved practices and changes in legislation may require a reinterpretation of the report in whole or in part.

Clancy Consulting Limited reserves the right to amend either conclusions or recommendations in light of any further information that may become available. The report is provided for the sole use of Twycross Zoo for the objectives discussed previously only and is confidential to them.

The report may not be relied upon by any other party without prior written consent of Clancy Consulting Limited. Those using this information in subsequent assessments or evaluations do so at their own risk.

It must be noted that whilst this investigation aims to characterise the general ground conditions beneath the proposed development site, Clancy Consulting Ltd cannot be held accountable for variations in ground and groundwater conditions, unidentified contamination or the presence of below ground structures present.

2.0 Summary of Previous Phase 1 Preliminary Risk Assessment

A summary of the previous Phase 1 Preliminary Risk Assessment undertaken for the site in August 2023 is provided below:

The site currently forms part of Twycross Zoo, including the 'Lemur Woods' in the north. A rural field is present in the south. The two sections are separated by a tree-line, running approximately southwest-northeast. The site slopes from north to south.

Twycross Zoo extends to the north and east of the site. Agricultural fields are present to the south and to the west beyond Orton Hill. A farm is located approximately 90m to the southwest of the site.

It is proposed to develop an area in the southwestern section of Twycross Zoo. This will include a new orangutan enclosure in the north of the development area comprising a two-storey steel frame structure, set into a sloping landscape with the potential for some earth retention structures. A cluster of single-storey buildings will be located in the south of the development area including educational spaces, laboratories and short stay accommodation.

The site comprised rural fields from at least 1885 until 1968. Mapping from 1989 indicated that Twycross Zoo had encroached into the eastern section of the site. The site was indicated to be present in its current layout on mapping from 2022 onward.

Surrounding land use was predominantly rural in nature until at least 1968. Orton House farm was located approximately 90m to the southwest of the site and a rectory approximately 150m to the northeast on mapping from at least 1885. Spinney Farm was present from approximately 150m to the west on mapping from 1955. Mapping from 1968 indicated that Twycross Zoo had been constructed and encroached to a distance of approximately 100m to the northeast and east of the site. Mapping from 1989 onwards indicate that the zoo had expanded and encroached into the eastern section of the site. Mapping from 2022 indicated that the zoo had expanded further and encroached onto the site from the north.

British Geological Survey mapping indicates that the site is underlain by Glaciofluvial Deposits and the Thrussington Member overlying mudstone of the Gunthorpe Member.

The radon guidance on protective measures for new dwellings indicates that the site is in a 'low' probability radon area where less than 1% of homes are estimated to be at or above the Action Level. Radon gas protection measures are therefore not required in the construction of new dwellings or extensions.

The site is not located within an area affected by coal mining.

The environmental database report indicates that the site represents a low risk with regard to ground stability issues relating to ground dissolution, shrinking and swelling clays, compressible ground, collapsible ground and landslides.

According to the Flood Map for Planning, available on the gov.uk website, the site is located within Flood Zone 1, whereby there is less than a 0.1% (1 in 1000) chance of flooding from rivers or the sea occurring each year.

The Glaciofluvial Deposits, indicated to be present beneath the site is classified by the Environment Agency (EA) as a Secondary A Aquifer. The Thrussington Member is classified as an Undifferentiated Secondary Aquifer. The underlying Gunthorpe Member is classified as a Secondary B Aquifer. According to EA data, the site is not located within a groundwater Source Protection Zone (SPZ). There are no records of licensed groundwater abstractions located within 500m of the site.

Two unnamed ponds are present to the north, on the wider Twycross Zoo site. A number of land drains are also indicated to be present on agricultural land in the vicinity of the site.

Zetica Bomb Risk mapping indicates that the site represents a low risk with respect to unexploded ordnance from the Second World War. On this basis, no further risk mitigation measures are considered to be required for intrusive works.

Given the limited development history of the site and absence of potentially contaminative land uses in its vicinity, the potential for elevated concentrations of contaminants of concern to be present in soils beneath the site is not considered to be significant. However, given the requirement for a geotechnical site investigation to enable the design of foundations and retaining walls for the proposed development, it would be prudent to analyse a limited number of soil samples to confirm their contamination status.

Significant sources of ground gas are not anticipated beneath the site. If encountered during intrusive works, wells may be installed in boreholes to allow monitoring and assessment of the potential risk posed by ground gas.

On the basis of the above, the following works were recommended:

- Carry out an intrusive site investigation to confirm ground conditions beneath the site.
- A limited number of soil samples should be recovered from selected exploratory holes and tested for potential contaminants of concern. This should include pH, metals, asbestos screening, speciated polycyclic aromatic hydrocarbons (PAH) and speciated total petroleum hydrocarbons (TPH).
- Monitoring wells should be installed in boreholes to allow measurement of groundwater level (if present) and to assess the potential risk posed by ground gas.
- Geotechnical testing should be carried out to provide information to enable preliminary foundation design.

3.0 Site Investigation

3.1 Investigation Design & Objectives

Pollutant linkages identified within the Preliminary Conceptual Site Model are currently active or will be made active upon redevelopment of the site. The investigation design approach was based on guidance provided in BS 10175 Code of Practice for Investigation of Potentially Contaminated Land (2011). The investigation also provided information on ground conditions and data for the assessment geotechnical properties of the strata underlying the site.

It must be noted that whilst this investigation aims to characterise the general ground conditions beneath the proposed development site, Clancy Consulting Limited cannot be held accountable for variations in ground and groundwater conditions, unidentified contamination or the presence of below ground structures in areas of the site which fall outside our borehole locations.

3.2 Fieldwork

Initial site investigation works were carried out between 6th and 14th September 2023 and comprised:

- Four rotary boreholes (BH01 to BH04) to depths of approximately 15.00m below ground level (bgl).
- One window sample borehole (WS05) to a depth of approximately 5.00m bgl.
- Two machine excavated trial pits (SA01 and SA02) to depths of up to 2.00m bgl.
- Soakaway testing in accordance with BRE Special Digest 365 in each trial pit.

It was not possible to carry out four other window sample boreholes, located in close proximity to an animal enclosure due to concerns about noise.

The second phase of site investigation works were carried out between 9th and 10th September 2024 and comprised:

- Eight window sample boreholes (WS01 to WS04 and WS06 to WS09) to depths of approximately 5.00m bgl.

A plan indicating the positions of the exploratory hole boreholes is provided in Appendix I. Exploratory hole logs are provided as Appendix II.

3.3 Laboratory Testing

Six samples of Made Ground and four samples of the Glaciofluvial Deposits were submitted to a UKAS/MCERTS accredited laboratory and analysed for a number of determinands including:

Inorganic Determinands:

pH, arsenic, beryllium, cadmium, chromium, hexavalent chromium, copper, lead, mercury, nickel, sulphate, selenium, vanadium, zinc and asbestos.

Organic Determinands:

PAH and TPH.

Chemical Laboratory Certificates are presented as Appendix III.

3.3.1 Geotechnical Laboratory Testing

Samples collected from the Made Ground, Glaciofluvial Deposits, Thrussington Member and Gunthorpe Member were analysed by a UKAS accredited laboratory for Atterberg Limits, particle size distribution (PSD), pH and water-soluble sulphate content. Geotechnical Laboratory Certificates are presented as Appendix IV.

4.0 Site Investigation Findings

4.1 Ground Conditions & Geotechnical Testing Parameters

The strata encountered during the intrusive investigation are summarised in the table below and described in the following section.

Table 1 – Encountered Strata

Strata	Depth to Top of Stratum (m bgl)	Thickness (m)
Made Ground	Ground level	0.20 to 1.4
Glaciofluvial Deposits	0.20 to 1.40	0.40 to 3.80
Thrussington Member	1.00 to 4.20	1.80 to 3.80 (where proven)
Gunthorpe Member	4.45 to 7.00	Not proven at a maximum depth of approximately 15.00m bgl

General descriptions of the strata encountered during the intrusive investigation are summarised below. Reference should be made to the borehole logs within Appendix II of this report for full descriptions of ground conditions underlying the site.

4.1.1 Made Ground

A limited thickness of Made Ground was recorded from ground surface at each exploratory hole position, ranging from approximately 0.20m to 1.40m.

The Made Ground was variable in nature, but generally comprised brown, clayey, gravelly sand. Gravel comprised fine to coarse, angular to subrounded limestone, chert and mudstone.

Visual or olfactory evidence of significant contamination was not identified within this stratum.

4.1.2 Glaciofluvial Deposits

Made Ground was underlain by layers of red-brown, clayey, sandy gravel / gravelly sand and sandy, gravelly clay, considered to be representative of the Glaciofluvial Deposits to depths ranging from approximately 1.00m to 4.20m bgl. Gravel comprised fine to coarse quartzite, chert and mudstone.

Glaciofluvial Deposits appeared to be absent in borehole WS05, located in the far south of the proposed development area.

13 SPTs undertaken within the Glaciofluvial Deposits at depths ranging from approximately 1.20m to 4.00m bgl gave results ranging from N = 0 to N = 16. This is representative of a very loose, ranging to a medium dense granular material. The stratum was generally at least medium dense. Loose soils were recorded locally in borehole BH02.

4.1.3 Thrussington Member

Glaciofluvial Deposits were underlain by soft to firm, grey, red and brown, mottled, sandy, gravelly clay, silty sand or gravel considered to be representative of the Thrussington Member, to depths ranging from approximately 4.45m to 7.00m bgl. The Thrussington Member was recorded directly beneath the Made Ground in borehole WS05 at a depth of approximately 0.45m bgl.

Atterberg Limit testing was undertaken on ten soil samples collected from the Thrussington Member at depths ranging from approximately 1.20m to 5.00m bgl. This testing was undertaken to determine values for Liquid Limit (LL), Plastic Limit (PL) and Plasticity Index (PI). The results for LL ranged from 22% to 47%. The results for PL ranged from 13% to 23%. The results for PI ranged from 10% to 25%. This is indicative of a variable material, ranging from a low to intermediate plasticity clay. Modified plasticity index values indicate that these samples have a low to moderate-volume change potential. The natural moisture content of these samples ranged from 13% to 38%.

38 SPTs undertaken within the Thrussington Member at depths ranging from approximately 1.20m to 6.00m bgl gave results ranging from N = 4 to N = 50. The SPTs undertaken within boreholes located in the south of the site gave results ranging from N = 8 to N = 50. The SPTs undertaken within boreholes located in the north of the site were generally lower ranging from N = 4 to N = 20; many of the low N values were recorded beneath the water table.

PSD testing was undertaken on one sample collected from a predominantly granular layer of the Thrussington Member in borehole WS07, located in the northern area of the site, at a depth of approximately 5.00m bgl. The constituents of the sample are summarised below:

- Gravel: 1%
- Sand: 85%
- Silt/clay: 14%

4.1.4 Gunthorpe Member

The Thrussington Member was underlain by weathered red mudstone, considered to be representative of the Gunthorpe Member, to a maximum proven depth of approximately 15.00m bgl. Detailed descriptions of this stratum can be found in the borehole logs, presented as Appendix II.

Atterberg Limit testing was undertaken on one soil sample collected from the Gunthorpe Member at a depth of approximately 7.00m bgl in borehole BH01. The result for LL was 35%. The result for PL was 23%. The result for PI was 12%. This is indicative of a low plasticity clay. Modified plasticity index values indicate that this sample has a low-volume change potential. The natural moisture content of this sample was 17%.

29 SPTs undertaken within the Gunthorpe Member at depths ranging from approximately 5.00m to 15.00m bgl generally gave results in excess of N = 50. One SPT undertaken within this stratum at a depth of 12.00m bgl in borehole BH01 gave a result of N = 43.

4.2 Groundwater

Groundwater strikes were not recorded within exploratory holes during the first phase of intrusive works. Groundwater levels recorded during subsequent monitoring visits are presented in the table below:

Table 2 – Groundwater Level Data

Monitoring Well ID	Well Screen Depth (m bgl)	Strata	Depth to Water (m bgl)					
			05/10/23	30/10/23	06/11/23	21/11/23	09/01/24	29/02/24
BH01	5.00 to 15.00	Gunthorpe Member	DRY	8.52	7.93	7.57	6.19	5.94
BH02	5.00 to 15.00	Gunthorpe Member	12.73	13.50	13.43	13.27	10.51	10.32
BH04	5.00 to 15.00	Gunthorpe Member	2.00	1.00	0.81	1.01	0.85	0.63

Groundwater was recorded in three exploratory holes during the second phase of site works. The groundwater table was recorded at 2.30m bgl in boreholes WS06 and WS07, and 3.10m bgl in borehole WS09.

Groundwater recorded in monitoring wells is considered to be representative of discontinuous perched groundwater restricted to granular horizons of the Thrussington Member and fissures within the Gunthorpe Member.

5.0 Hazardous Ground Gas Assessment

5.1 Introduction

The site has not had a significant development history and potentially significant sources of ground gas were not identified in the surrounding area. However, a limited thickness of Made Ground was recorded beneath the site during the intrusive investigation works, which may represent a source of ground gas.

5.2 Scope of Works

Ground gas monitoring wells were installed in three boreholes as part of the first phase of works. A further three monitoring wells were installed in boreholes as part of the second phase of works. Given the limited thickness of Made Ground identified in boreholes, the response zones positioned within the Glaciofluvial Deposits, Thrussington Member and Gunthorpe Member.

A monitoring programme comprising six monitoring visits over a period of three months was undertaken as part of the first phase of works in accordance with the guidance within CIRIA Report C665 'Assessing risks posed by hazardous ground gases to buildings. A further visit was undertaken as part of the second phase of works to monitor ground gas concentrations and flow rates within wells installed at this time.

5.3 Monitoring Results

Six ground gas monitoring visits have been carried out from 5th October to 29th February 2024. A further monitoring visit took place on 11th October 2024. Atmospheric pressure ranged from 976mb to 1016mb during the visits. Copies of the results are presented in Appendix V and summarised in the table below.

Table 3 – Gas Monitoring Results

Hole ID	Max Methane (%v/v)	Max Carbon Dioxide (%v/v)	Flow Rate (l/hr)	Gas Screening Value (l/hr)	Characteristic Situation
BH01	<0.1	3.0	<0.1	0.0030	CS1
BH02	<0.1	0.7	9.0	0.0630	CS1
BH04	<0.1	0.8	<0.1	0.0008	CS1
WS01	<0.1	2.5	0.7	0.0175	CS1
WS04	<0.1	2.1	<0.1	0.0021	CS1
WS07	0.1	11.2	<0.1	0.0112	CS1

Installations were monitored for concentrations of methane, carbon dioxide and oxygen. In addition, the flow rate and barometric pressure were recorded.

Methane was recorded at concentrations in excess of the instrument limit of detection (less than 0.1% by volume (v/v)).

Carbon dioxide was recorded at a maximum steady concentration of 11.2% v/v within monitoring well WS07 on 11th October 2024.

A maximum ground gas flow rate of 9.0 litres per hour was recorded within monitoring well BH02 on 29th February 2024.

The lowest recorded oxygen concentration was <0.1% v/v within monitoring well WS07 on 11th October 2024.

It should be noted that monitoring well BH01 was blocked at the time of the visit on 5th October 2023 and readings could not be taken on this occasion.

5.4 Discussion

The CIRIA Report C665 outlines indicative guideline concentrations for carbon dioxide and methane in association with gas flow rates for which gas protection measures may be required in new residential or commercial developments. The methodology is based on the Modified Wilson and Card approach that

characterises the gas regime into a series of Characteristic Situations (1 to 5), with corresponding indicative gas protection measures.

Using this methodology, the ground gas regime corresponds to CIRIA Characteristic Situation 1 (CS1), whereby ground gas protection measures are not required for new buildings. However, the guidance states that consideration should be given to raising to CIRIA CS2 where carbon dioxide concentrations exceeding 5%v/v are recorded (such as in monitoring well WS07 on 11th October).

Plotting of gas concentrations recorded in monitoring well WS07 on a Ternary chart indicates that these are likely to be representative of microbial action within the soils. On this basis, and given the low ground gas flow rate in this location, it is considered that CIRIA CS1 remains appropriate for the proposed development.

6.0 Tier 1 Contamination Analysis

The field investigation findings indicate that pathways are present by which contaminants of concern can impact identified receptors. Chemical analysis has been carried out on soils sampled from beneath the site. The concentrations of contaminants of concern within soil can be compared to assessment criteria (AC) to determine whether these represent an unacceptable risk to identified receptors. The derivation of AC to be used and the comparison of these criteria to the results of the chemical analyses are presented below.

6.1 Human Health Assessment Criteria

In order to assess risks to future site users, concentrations of contaminants of concern have been compared to Suitable 4 Use Levels (S4UL) generic AC published by Land Quality Management: Chartered Institute of Environmental Health (LQM:CIEH) in 2015.

As a conservative measure, the assessment has been based upon the use of the site for residential purposes with plant uptake, based its use as an Orangutang enclosure in the northern section and including short stay accommodation in the south.

As a conservative measure, concentrations of contaminants of concern have been compared to the S4UL (1.00% Soil Organic Matter) values.

A notable exclusion from the S4ULs is lead. In the absence of a S4UL for lead, the Category 4 Screening Level (C4SL) has been selected, published by DEFRA in 2014. It is noted that the C4SL are based on the acceptance of a low level of toxicological concern, rather than the more conservative standard adopted in the derivation of S4ULs, which are based on a tolerable or minimal level of risk.

The potential risk posed to controlled waters from contaminants of concern within soils beneath the site is not addressed by these screening criteria.

6.2 Comparison of Soil Analyses to Human Health Assessment Criteria

Chemical analysis was undertaken on six samples of Made Ground and four samples of the Glaciofluvial Deposits. A comparison of soil analyses to the relevant AC is presented below.

6.2.1 Inorganic Determinands

Inorganic contaminants of concern were not recorded within soil samples analysed from beneath the site at concentrations in excess of adopted AC.

6.2.2 Organic Determinands

PAH contaminants of concern were not recorded within soil samples analysed from beneath the site at concentrations in excess of adopted AC.

TPH contaminants of concern were not recorded within soil samples analysed from beneath the site at concentrations in excess of adopted AC

6.2.3 Asbestos

Asbestos containing materials (ACMs) were not identified in any of the soil samples submitted for screening.

7.0 Contamination Assessment

7.1 Introduction

Based on the information obtained during the ground investigation and laboratory testing, the 'Preliminary Conceptual Site Model' has been amended accordingly. The Conceptual Site Model is used as a basis to identify contamination sources, pathways and receptors and is subject to constant refinement as more information becomes available.

7.2 Human Health Receptors

Contaminants of concern were not recorded in soil samples analysed from beneath the site at concentrations in excess of adopted AC.

On this basis, contamination beneath the site is not considered to pose a significant risk to human health receptors.

7.3 Construction / Maintenance Workers

S4UL screening criteria cannot be used to assess the acute (short term exposure) risk that personnel in close contact with exposed soils may experience during construction/site maintenance duties.

Potential risks to construction/maintenance workers can be controlled by the use of appropriate personal protection equipment (e.g. disposable coveralls, gloves and particulate/vapour masks) and by adopting high levels of personal hygiene.

7.4 Groundwater

The site is underlain by a Secondary A Aquifer relating to the Glaciofluvial Deposits and an Undifferentiated Secondary Aquifer, relating to the Thrussington Member. The underlying Gunthorpe Member is classified as a Secondary B Aquifer. The site is not located within a groundwater SPZ and there are no records of licensed groundwater abstractions located within 500m of the site. Furthermore, significantly elevated concentrations of contaminants of concern, considered to represent a significant risk to groundwater resource receptors, were not recorded in soil sampled from beneath the site.

On this basis, groundwater resource receptors are not considered to be at significant risk from contaminants of concern recorded in soil samples analysed from beneath the site.

7.5 Surface Water

Two unnamed ponds are present to the north, on the wider Twycross Zoo site. A number of land drains are also indicated to be present on agricultural land in the vicinity of the site. However, significantly elevated concentrations of contaminants of concern, considered to represent a significant risk to surface water receptors, were not recorded in soil sampled from beneath the site.

7.6 Polymeric Utility Pipes

Hydrocarbon contaminants were not recorded in soil samples analysed from beneath the site at concentrations considered potentially harmful to potable water supply pipes. Standard polymeric utility pipes are therefore considered likely to be suitable for the proposed development.

Requirements for buried utility pipes should be discussed with service providers before the development stage.

7.7 Revised Conceptual Site Model

The potential source-pathway-receptor linkages and associated risks upon completion of the proposed development at the site, as identified following completion of the assessment, are summarised in the table below.

Table 4 – Revised Conceptual Site Model

Potential Source	Via	Potential Pathways	Linkage Potentially Active? (Yes/No)	Receptors
On site: Made Ground	Soil	Direct contact/ingestion	No	Site users
		Inhalation of volatiles	No	
		Airborne migration of soil or dust	No	Off-site users
		Leaching of mobile contaminants	No	Glaciofluvial Deposits, Secondary A Aquifer Thrussington Member Undifferentiated Secondary Aquifer Gunthorpe Member Secondary B Aquifer
	Groundwater	Direct contact/ingestion	No	Site users
			No	Off-site users
		Inhalation of volatiles	No	Site users
			No	Off-site users
		Vertical and lateral migration in permeable strata	No	Glaciofluvial Deposits, Secondary A Aquifer Thrussington Member Undifferentiated Secondary Aquifer Gunthorpe Member Secondary B Aquifer
			No	Ponds and land drains
Off site: Farms, wider zoo	Groundwater	Direct contact/ingestion	No	Site users
		Inhalation of volatiles	No	Site users
	Service conduits	Direct contact/ingestion	No	Site users
		Inhalation of volatiles	No	Site users
Potential hazardous ground gas and vapours from Made Ground (if present)	Ground Gas	Inhalation of ground gas	No	Site users
			No	Off-site users
		Explosive risks	No	Site users
			No	Off-site users

The risk assessment is based upon the available information relating to the site. Should ground conditions inconsistent with those outlined in this report be encountered CCL should be contacted to enable further assessment. The findings of the CSM should be confirmed upon finalisation of the proposed redevelopment plans.

8.0 Geotechnical Assessment

8.1 Introduction

It is proposed to develop the area with a new orangutan enclosure in the north of the proposed development area, comprising a two-storey steel frame structure, set into a sloping landscape with the potential for some earth retention structures. A cluster of single-storey buildings will be located in the south, including educational spaces, laboratories and short stay accommodation.

No preliminary structural loads have been received for the proposed development. Therefore, the preliminary recommendations below will need to be reviewed at the detailed design stage once these are known.

8.2 Preliminary Geotechnical Risk Register

The table below summarises the potential geotechnical hazards associated with the development. The table provides an assessment of whether the site is likely to be affected by the hazard and the possible consequences and engineering considerations.

Table 5 – Geotechnical Risk Register

Hazard Description	Is hazard likely to be present / affect the site?	Comments/possible engineering requirements where hazard present
Sudden lateral/vertical changes in ground conditions	M	A limited thickness of Made Ground was recorded beneath the site, overlying the Glaciofluvial Deposits and Thrussington Member. These superficial deposits were underlain by mudstone of the Gunthorpe Member. The main variation in ground conditions is considered likely to be associated with the composition and strength characteristics of the shallow natural superficial deposits.
Highly compressible/low bearing capacity soils, (including peat and soft clay)	M	The Glaciofluvial Deposits were generally at least medium dense at shallow depth. Loose soils were recorded locally in borehole BH02, WS06, WS07 and WS09. Soft soils were observed within the upper layers of the Thrussington Member, becoming firmer with depth.
Ground dissolution features/natural cavities	L	Soils recorded beneath the site are not susceptible to these hazards.
Shrinking and swelling clays	M	Samples tested from the Thrussington Member had a low to moderate-volume change potential. Foundations should be designed in accordance with Appendix 4.2H of the NHBC guidance (Building Near Trees).
Slope stability/Retaining wall issues	M	It is proposed to develop the area with a new orangutan enclosure in the north, comprising a two-storey steel frame structure, set into a sloping landscape with the potential for some earth retention structures. Any temporary or permanent slopes or retaining walls created as part of the development should be subject to appropriate geotechnical design based on site-specific site investigation information.
High groundwater table (including waterlogged ground)	L/M	Shallow perched groundwater was recorded in the Thrussington Member in borehole BH04, WS06, WS07 and WS09. Deeper perched groundwater was recorded in the Thrussington Member in monitoring wells BH01 and BH02. If shallow perched groundwater is encountered during foundation excavations, this may be controlled via pumping from a localised sump.
Filled and Made Ground (including embankments)	L	A limited thickness of Made Ground was recorded beneath the site, overlying superficial nature soils.
Obstructions (including foundations, services, basements, tunnels and adjacent sub-structures)	L	The site has had a limited development history. If relic foundations and services are encountered, it is considered likely that these may be removed using standard construction plant.

Hazard Description	Is hazard likely to be present / affect the site?	Comments/possible engineering requirements where hazard present
Underground mining	L	The site is not located within an area affected by coal mining.
Concrete classification	L	Testing indicates that that a Design Sulphate Class of DS1 and an Aggressive Chemical Environment for Concrete (ACEC) Classification of AC1 would be suitable for all buried concrete structures.
Seismic Activity	L	The Eurocode 8 seismic hazard zoning maps for the UK (Musson and Sargeant, 2007) indicate that horizontal Peak Ground Acceleration (PGA) values with 10% probability of being exceeded in 50 years (475 year return period) are between 0.00g and 0.02g, which is considered very low.
NOTES: H – High Risk M – Medium Risk L – Low risk		

8.3 Foundation Solutions

8.3.1 Traditional Foundations

Based upon SPT results, the Glaciofluvial Deposits are likely to provide a suitable bearing stratum for traditional foundations supporting lightly loaded structures, where it is at least medium dense granular or firm cohesive material at foundation bearing depth (assessed to be from approximately 1.50m bgl).

In accordance with the guidance set out in Eurocode 7, a 2.00m wide concrete pad foundation placed at a depth of 1.50m bgl should be capable of supporting building loads of up to 125kN/m².

Subsequent to foundation excavation, in accordance with the guidance set out in Eurocode 7 to satisfy Ultimate Limit State (ULS) and Serviceability Limit State (SLS) design, settlement underlying a 2.00m wide concrete pad foundation, constructed in the manner discussed above, is estimated to be within acceptable limits (<25mm). Settlements in excess of 25mm should be anticipated for larger pad foundations supporting heavier column loads.

The formation should be inspected by the site engineer before placing foundations. If Made Ground, low strength cohesive or loose granular material is encountered at the target bearing depth, foundations should be taken deeper to an appropriate formation level or unsuitable material should be excavated and replaced with compacted granular fill.

8.3.2 Ground Improvement

It is understood that larger column loads are anticipated for the Orangutan Enclosure in the northern section of the site.

Loose soils were recorded at shallow depth in boreholes BH02, WS06, WS07 and WS09, located in the northern section of the site. Low SPT results in the granular soils were obtained at depths below the recorded groundwater level, indicating that these results were likely associated with 'blowing sands', whereby groundwater uplift pressure locally loosens granular soil during drilling.

On the basis of the above, we would recommend placing foundations above the recorded groundwater level. Ground improvement via vibro stone columns would likely be a suitable method of treating soils to allow higher foundation bearing pressures at shallower depth. Typically, allowable bearing pressures of up to 150kN/m² are achievable following successful treatment via vibro stone columns. However, this should be confirmed following discussions with a specialist contractor.

Alternatively, piled foundations could be adopted.

8.3.3 Piled Foundations

Where higher loads are anticipated, it is considered that piled foundations would be required to support the proposed development. Bored or CFA piles, terminating in the deeper Gunthorpe Member are likely to be most suitable on the subject site from a geotechnical viewpoint.

Preliminary anticipated bored or CFA pile bearing capacities are detailed in the table, below:

Table 6 – Anticipated Preliminary Pile Capacities

Pile Length m	Pile Diameter		
	450mm	600mm	750mm
8	355kN	540kN	765kN
9	470kN	700kN	960kN
10	585kN	855kN	1155kN
11	705kN	1010kN	1350kN
12	820kN	1165kN	1545kN

A piling contractor should be consulted with regard to detailed pile design, since the type of pile and method of installation adopted will affect capacity.

Partial safety factors have been applied to the calculated preliminary pile capacities above in accordance with Design Approach 1: Combination 2, as detailed within Tables A.6, A.7 and A.8 of Annex A in BS EN 1997-1. This was found to be the most conservative design approach.

It should be noted that no design loads have been received at this stage. It is recommended that when the final structural loads have known further detailed assessment of pile capacity will need to be undertaken in accordance with the recommendations provided in Eurocode 7.

Loads are based on single piles only and do not take into account the action of groups of piles. This should be considered at the detailed design stage.

The pile capacity estimates presented above are preliminary and based on a conservative soil profile derived from boreholes drilled beneath the site. The adopted pile profile is summarised as follows:

Table 7 – Adopted Soil Profile

Stratum	Depth (m bgl)	Bulk Density (kN/m ³)	Shear Strength (kN/m ²)	Nc	Soil/Pile Friction Angle (°)	Nq
Made Ground	GL to 1.00	18	Not taken into account			
Glaciofluvial Deposits	1.00 to 4.00	20	N/A	N/A	20	13
Thrussington Member	4.00 to 7.00	20	40	9	N/A	N/A
Gunthorpe Member	7.00 to 15.00	20	225	9	N/A	N/A

An appropriate piling platform should be designed and constructed in accordance with BRE Digest 470 (Working platforms for Tracked Plant).

8.4 Retaining Walls

It is proposed to develop the area with a new orangutan enclosure in the north of the proposed development area, comprising a two-storey steel frame structure, set into a sloping landscape with the potential for some earth retention structures.

The following soil profile is considered appropriate for the calculation of earth pressures and design of the retaining wall:

Table 8 – Soil Profile from Crest of Existing Retaining Wall

Stratum	Depth m bgl	Bulk Density (kN/m ³)	Cu(kN/m ²)	C' (kN/m ²)	Φ'(°)
Made Ground	GL to 1.00	18	N/A	0*	30*
Glaciofluvial Deposits	1.00 to 4.00	20	N/A	0*	32*
Thrussington Member	4.00 to 7.00	20	40**	0*	23*
Gunthorpe Member	7.00 to 15.00	20	225 **	5*	23*

* Conservative assumption.

** Moderately conservative value, based on *in situ* and/or laboratory testing.

It should be noted that the actual coefficient of earth pressure used for design should reflect the form of construction employed and any temporary works required. The design of any temporary or permanent retaining structure should be undertaken in accordance with the guidance provided in Eurocode 7.

8.5 Temporary Works and Excavations

The site has had a limited development history. If relic foundations and services are encountered, it is considered likely that these may be removed using standard construction plant.

Shallow groundwater was recorded in the Thrussington Member in borehole BH04. Deeper groundwater was recorded in the Thrussington Member in monitoring wells BH01 and BH02. Groundwater recorded in monitoring wells is considered to be representative of discontinuous perched groundwater restricted to granular horizons of the Thrussington Member and fissures within the Gunthorpe Member. If shallow perched groundwater is encountered during foundation excavations, this may be controlled via pumping from a localised sump.

If groundwater is encountered during excavation, degradation of the formation may occur. The formation should therefore be adequately protected from seepages and protected from adverse weather conditions. If the formation layer becomes wet resulting in softening or loosening of the surface materials, then excavation may have to be taken deeper in order to find a suitable bearing layer. Instability of excavations in granular material should be expected, especially during periods of adverse weather. Suitable shoring measures or battering back of slopes may be required for any excavations greater than 1.20m bgl. All temporary excavations should be undertaken in accordance with CIRIA Report 97 'Trenching Practice'.

8.6 Chemical Attack on Buried Concrete

Samples of the Made Ground, Glaciofluvial Deposits, Thrussington Member, Gunthorpe Member were tested for pH and for sulphate content. The results are presented below:

Table 9 – Results of pH and sulphate testing

Stratum	No. Samples	Range of pH	Characteristic pH	Range of Sulphate (mg/kg)	Characteristic Sulphate (mg/kg)	Design Sulphate Class	ACEC Class
Made Ground	4	7.21 to 7.88	7.21	<10 to 20	20	DS1	AC1
Glaciofluvial Deposits	6	6.75 to 7.79	6.87	<10 to 30	30	DS1	AC1
Thrussington Member	3	7.17 to 7.29	7.17	<10 to 40	40	DS1	AC1
Gunthorpe Member	1	8.40	8.40	40	40	DS1	AC1

The data was used to assess appropriate concrete classification for buried concrete in accordance with BRE Special Digest 1, based on the following assumptions:

- Brownfield ground conditions.
- Mobile groundwater conditions.

- For a dataset of less than five samples, the characteristic value for soluble sulphate has been taken as the highest result, while the characteristic value for pH is taken as the lowest pH result.
- For a dataset of between five and nine samples, the characteristic value for soluble sulphate has been taken as the average of the highest two results, while the characteristic value for pH is taken as the average of the lowest two pH results.

Based on the above, it is considered that a Design Sulphate Class of DS1 and an Aggressive Chemical Environment for Concrete (ACEC) Classification of AC1 would be suitable for all buried concrete structures.

8.7 Soakaway Testing

Soakaway testing was undertaken in accordance with BRE Special Digest 365 in trial pits SA01 and SA02 over depths ranging from approximately 1.00m to 2.00m bgl within the Glaciofluvial Deposits.

In each case, water added to the pits did not drain to 75% of original depth over the 24-hour period of the test. Approximate extrapolated infiltrations rates were 6×10^{-7} m/s for the test in trial pit SA01 and 9×10^{-7} m/s for the test undertaken in trial pit SA02. These extrapolated calculations assume a linear rate of infiltration and therefore actual infiltration rates may have been lower than this.

The low recorded infiltration rates are considered to be due to the cohesive content of the soils the tests were undertaken within. Deeper boreholes undertaken on site indicate that the cohesive content of soils increased with depth, so it is considered that the permeability of soils would likely decrease with depth.

On the basis of the above, soakaway chambers are considered unlikely to be a suitable method to discharge surface water runoff from the proposed development. However, this should be confirmed by the drainage engineer.

9.0 Conclusions and Recommendations

Clancy Consulting Limited was instructed by Twycross Zoo to carry out a Phase 2 Site Investigation for a development site located in the southwest of Twycross Zoo, Norton Grange, Burton Road, Atherstone CV9 3PX. The site currently forms part of Twycross Zoo, including the 'Lemur Woods' in the north. A rural field is present in the south. The two sections are separated by a tree-line, running approximately southwest-northeast.

It is proposed to develop the area with a new orangutan enclosure in the north, comprising a two-storey steel frame structure, set into a sloping landscape with the potential for some earth retention structures. A cluster of single-storey buildings will be located in the south of the development area including educational spaces, laboratories and short stay accommodation.

The first phase of site investigation comprised four rotary drilled boreholes (BH01 to BH04) to depths of approximately 15.00m bgl, one window sample borehole (WS05) to a depth of approximately 5.00m bgl and two machine excavated trial pits (SA01 and SA02) to depths of up to 2.00m bgl. Soakaway testing in accordance with BRE Special Digest 365 undertaken in each trial pit.

The second phase of site investigation comprised four window sample boreholes (WS01 to WS04) to depths of approximately 5.00m bgl in the south of the site and four window sample boreholes (WS06 to WS09) to depths of approximately 5.00m bgl in the north between the positions of rotary boreholes (BH01 and BH02) to delineate the area of previously identified loose soils.

A limited thickness of Made Ground was recorded from ground surface at each exploratory hole position, ranging from approximately 0.20m to 1.40m. Made Ground was underlain by layers of red-brown, clayey, sandy gravel / gravelly sand and sandy, gravelly clay, considered to be representative of the Glaciofluvial Deposits to depths ranging from approximately 1.00m to 4.20m bgl. Glaciofluvial Deposits were underlain by soft to firm, grey, red and brown, mottled, sandy, gravelly clay, silty sand or gravel considered to be representative of the Thrussington Member, to depths ranging from approximately 4.45m to 7.00m bgl. The Thrussington Member was underlain by weathered red mudstone, considered to be representative of the Gunthorpe Member, to a maximum proven depth of approximately 15.00m bgl.

Contaminants of concern were not recorded in soil samples analysed from beneath the site at concentrations in excess of adopted AC, protective of residential site users. On this basis, contamination beneath the site is not considered to represent a significant risk to future site users.

Significantly elevated concentrations of contaminants of concern, considered to represent a risk to groundwater or surface water resource receptors, were not recorded in soil sampled from beneath the site.

Based on monitoring undertaken at the site, the ground gas regime corresponds to CS1. On this basis, ground gas protection measures would not be required for new structures at the site.

Based on SPT results, the Glaciofluvial Deposits are likely to provide a suitable bearing stratum for traditional foundations supporting lightly loaded structures, where it is at least medium dense granular or firm cohesive material at foundation bearing depth (assessed to be from approximately 1.50m bgl).

It is understood that larger column loads are anticipated for the Orangutan Enclosure in the northern section of the site. Loose soils were recorded at shallow depth in boreholes BH02, WS06, WS07 and WS09, located in the northern section of the site. Low SPT results in the granular soils were obtained at depths below the recorded groundwater level, indicating that these results were likely associated with 'blowing sands', whereby groundwater uplift pressure locally loosens granular soil during drilling.

On the basis of the above, we would recommend placing foundations above the recorded groundwater level. Ground improvement via vibro stone columns would likely be a suitable method of treating soils to allow higher foundation bearing pressures at shallower depth. Typically, allowable bearing pressures of up to 150kN/m² are achievable following successful treatment via vibro stone columns. However, this should be confirmed following discussions with a specialist contractor. Alternatively, piled foundations could be adopted.

Soil infiltration rate testing was undertaken in accordance with BRE Special Digest 365 in trial pits SA01 and SA02 over depths ranging from approximately 1.00m to 2.00m bgl within the Glaciofluvial Deposits.

In each case, water added to the pits did not drain to 75% of original depth over the 24-hour period of the test. Approximate extrapolated infiltrations rates were 6×10^{-7} m/s for the test in trial pit SA01 and 9×10^{-7} m/s for the test undertaken in trial pit SA02. These extrapolated calculations assume a linear rate of infiltration and therefore actual infiltration rates may have been lower than this.

The low recorded infiltration rates are considered to be due to the cohesive content of the soils the tests were undertaken within. Deeper boreholes undertaken on site indicate that the cohesive content of soils increased with depth, so it is considered that the permeability of soils would likely decrease with depth.

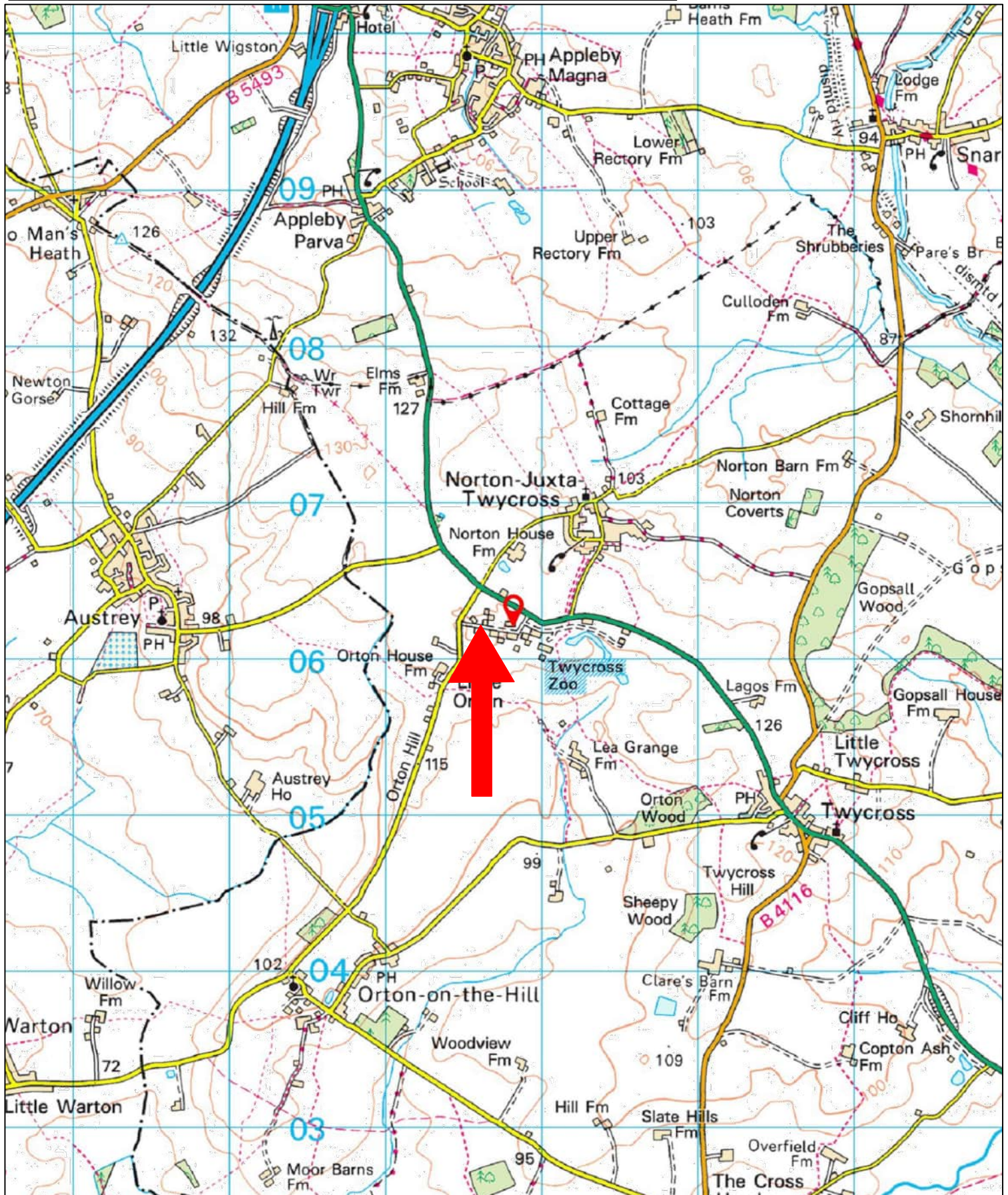
On the basis of the above, soakaway chambers are considered unlikely to be a suitable method to discharge surface water runoff from the proposed development. However, this should be confirmed by the drainage engineer.

APPENDIX I
DRAWINGS

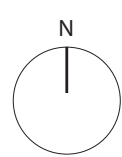
Client	Twycross Zoo
Project	New Orangutan Enclosure
Title	Site Location Plan
Office	Birmingham
Discipline	Geo



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							Drawn	PJH	Date	08/12/2022	COPYRIGHT: THE COPYRIGHT OF THIS DRAWING IS VESTED IN CLANCY CONSULTING. IT SHALL NOT BE USED WITHOUT PERMISSION BY ANYONE FOR ANY PURPOSE. DO NOT SCALE THIS DRAWING ELECTRONICALLY OR MANUALLY. WORK TO FIGURED DIMENSIONS ONLY. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE. DO NOT TURN ON LAYERS THAT HAVE BEEN TURNED OFF. DO NOT THAW LAYERS THAT HAVE BEEN FROZEN.	Job number	Drawing number	Revision
						Checked	RP	Scale	@ A4	NTS		10/2197	001	-
						Approved	RP	Status	Live					
xx	xx.xx.xx	xxx		xxx	xx	xxx								
Rev	Date	Description		By	Check	App.								





Rev	Date	Description	By	Check	App.
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Client	Twycross Zoo
Project	Twycross Zoo
Office	Birmingham
Discipline	Geo-Environmental
Title	Exploratory Hole Location Plan

Scale @ A3	NTS	Status	Draft
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Originator	Job Number	Discipline	Building/Zone
SRP	10/2197	Geo	-
Type	Level	Drawing No.	Revision
-	-	002	-

APPENDIX II
EXPLORATORY HOLE LOGS



Project Title: Twycross Zoo

Project Number: 10/2197

Client: Twycross Zoo - East Midlands Zoological Society

GL (mAOD):

N Coord: 0

E Coord: 0

Date: 06/09/2023-08/09/2023

Method: Rotary Rig

Driller: Geotron

Logged By: SRP

Core/Samples	TCR	SCR	RQD	FI	ISPT	Level	Legend	Depth (m)	Description	Water	Standpipe
0.50 ES								0.70	MADE GROUND: Brown/ red slightly clayey gravelly fine to coarse sand. Gravel is angular to sub-rounded fine to coarse of chert and mudstone. Brown/ red slightly clayey gravelly fine to coarse SAND. Gravel is sub-angular to sub-rounded fine to coarse of chert and mudstone. Brown/ red slightly gravelly clayey fine to coarse SAND. Gravel is angular to sub-rounded fine to coarse of mudstone. Brown/ red slightly clayey sandy GRAVEL. Gravel is angular to sub-rounded fine to coarse of mudstone. Brown/ red firm CLAY.		
1.20 D					N=9			1.00			
2.00 D					N=13			1.90			
								2.00			
3.00 D					N=9			2.20			
								3.00			
								3.80			
5.00 D					N=8			4.00			
6.00 D					N=19			5.00			
7.00 D					N=50			6.00			
7.00-7.50	100		60	10				7.00	Red weathered MUDSTONE.		
								8.00			
7.50-9.00	100		33	7				9.00			
				13		pp 50/300mm		10.00			
9.00-10.50	100		37	14		pp 50/275mm		11.00			
				8				12.00			
10.50-12.00	100		30	1				13.00			
				2				14.00			
				3	N=43			15.00			
12.00-13.50	100		53	3		pp 50/230mm		16.00			
				5					End Of Borehole At 15.00 m		
13.50-15.00	100		40	12		pp 50/295mm					
				3							
				5							
				1							

KEY

D - Disturbed Sample
B - Bulk Sample
U - Undisturbed
W - Water Sample
S - Standard Penetration Test
C - Cone Penetration Test
N - Penetration Test 'N' Value
V - Hand Shear Vane kPa
 - Groundwater Strike
 - Groundwater Level



REMARKS

No Groundwater Encountered

Scale: 1:100

Water Strikes

Date	Strike	Level	Minutes	Casing	Remarks

Daily Log Of Depths

Flushing Medium

Date	Casing	Water	From	To	Type

Printed By GeoLogs (www.GeoLogs.com)

		Project Title: Twycross Zoo					BH02																																								
		Project Number: 10/2197		Client: Twycross Zoo - East Midlands Strategic Society																																											
		GL (mAOD):		N Coord: 0			E Coord: 0																																								
Date: 12/09/2023-15/09/2023		Method: Rotary Rig		Driller: Geotron			Logged By: SRP																																								
Core/Samples	TCR	SCR	RQD	FI	ISPT	Level	Legend	Depth (m)	Description	Water	Standpipe																																				
0.20-0.30 ES								0.40	MADE GROUND: Grass over dark brown slightly gravelly sandy clay. Sand is fine to coarse. Gravel is sub-angular to sub-rounded fine to coarse of quartzite, limestone and mudstone.																																						
1.20 D					N=10			1.00																																							
2.00 D					N=5			1.90 2.00																																							
3.00 D					N=0			2.70 3.00	Soft brown slightly sandy gravelly CLAY. Gravel is rounded fine to coarse of mudstone and quartzite.																																						
4.00 D					N=3			4.00 4.20	Soft red/ brown sandy CLAY. Sand is fine to medium.																																						
5.00 D					N=6			5.00	Red/ brown clayey fine to medium SAND.																																						
								6.00	Soft to firm red sandy CLAY.																																						
						pp 50/295mm		7.00	Red weathered MUDSTONE.																																						
						pp 50/300mm		8.00																																							
						pp 50/295mm		9.00																																							
						pp 50/275mm		10.00																																							
						pp 50/225mm		11.00																																							
					N=50			12.00																																							
								13.00																																							
								14.00																																							
								15.00																																							
								16.00	End Of Borehole At 15.00 m																																						
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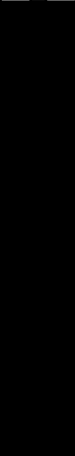
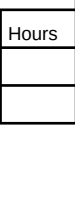
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		Project Number: 10/2197		Client: Twycross Zoo - East Midlands Zoological Society																																																			
		GL (mAOD):		N Coord: 0			E Coord: 0																																																
Date: 12/09/2023-13/09/2023		Method: Rotary Rig		Driller: Geotron			Logged By: SRP																																																
Core/Samples	TCR	SCR	RQD	FI	ISPT	Level	Legend	Depth (m)	Description	Water	Standpipe																																												
0.10 ES								0.35	MADE GROUND: Grass over dark brown slightly clayey gravelly fine to coarse sand. Gravel is sub-rounded to rounded fine to coarse of mudstone and chert with occasional rootlets. Red/brown slightly gravelly slightly clayey fine to coarse SAND. Gravel is rounded fine to coarse of mudstone. Soft red slightly gravelly sandy CLAY. Gravel is angular to sub-rounded fine to coarse of quartzite and mudstone. Soft red gravelly CLAY. Gravel is angular to sub-rounded fine to coarse of mudstone and quartzite. Firm red slightly sandy CLAY. Stiff grey mottled red CLAY. Red weathered MUDSTONE.																																														
1.00 ES								1.00																																															
1.50 D					N=10			1.85																																															
2.00 D					N=16			2.00																																															
3.00 D					N=7			2.90																																															
4.00 D					N=5			3.00																																															
5.00 D					N=15			3.40																																															
								4.00																																															
								5.00																																															
								5.60																																															
6.00-7.50	100		7	3	pp 50/275mm			6.00																																															
				6	pp 50/260mm			7.00																																															
7.50-9.00	100		57	9				8.00																																															
				6	pp 50/290mm			9.00																																															
9.00-10.50	100		50	7				10.00																																															
				6	pp 50/240mm			11.00																																															
					pp 50/235mm			12.00																																															
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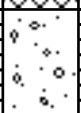
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		Project Number: 10/2197		Client: Twycross Zoo - East Midlands Society																																									
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Date: 12/09/2023-14/09/2023		Method: Rotary Rig		Driller: Geotron			Logged By: SRP																																						
Core/Samples	TCR	SCR	RQD	FI	ISPT	Level	Legend	Depth (m)	Description	Water	Standpipe																																		
0.70 ES								0.35	MADE GROUND: Grass over dark brown slightly gravelly sandy clay. Gravel is sub-rounded to rounded fine to coarse of chert, quartzite and mudstone.																																				
1.20 D					N=10			1.00																																					
2.00 D					N=13			2.00	Soft brown/ red sandy slightly gravelly CLAY. Gravel is rounded fine to coarse of quartzite, chert and mudstone.																																				
3.00 D					N=7			3.00																																					
4.00 D					N=10			4.00	Soft to firm red slightly sandy slightly gravelly CLAY. Gravel is angular to sub-angular fine to medium of mudstone.																																				
5.00 D					pp 50/239mm			5.00																																					
								6.00	Red weathered MUDSTONE.																																				
					pp 50/265mm			6.00																																					
								7.00																																					
					pp 50/230mm			8.00																																					
					pp 50/245mm			9.00																																					
					pp 50/255mm			10.00																																					
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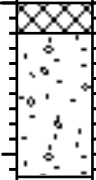
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		Project Number: 10/2197		Client: Twycross Zoo - East Midlands Zoological Society			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 12/09/2023		Method: Window Sampler		Driller: Geotron		Logged By: SRP	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.50	ES				0.45	MADE GROUND: Dark brown slightly gravelly clayey fine to coarse sand. Gravel is sub-angular to rounded fine to coarse of mudstone, chert and limestone.		
					0.60			
1.20	D	N=12			1.00	Soft red/ brown slightly sandy gravelly CLAY. Gravel is sub-angular to sub-rounded fine to coarse of mudstone and limestone.		
					1.35			
2.00	D	N=12			2.00	Soft red/ brown sandy slightly gravelly CLAY. Gravel is sub-rounded fine to medium of mudstone and quartzite.		
					2.65			
3.00	D	N=11			2.90	Soft grey mottled red/ brown slightly gravelly sandy CLAY. Gravel is sub-angular fine to medium of mudstone.		
					3.00			
					3.50	Firm red/brown sandy CLAY.		
					4.00	Soft red/brown sandy CLAY. (Wet)		
4.00	D	N=25			4.00	Firm red/brown slightly sandy gravelly CLAY. Gravel is angular to sub-angular fine to coarse of mudstone (weathered mudstone)		
					4.45			
					5.00	Stiff grey mottled red/brown CLAY. (Weathered mudstone)		
5.00	D	pp 91/230mm			5.35			
					6.00	End Of Borehole At 5.35 m		
					7.00			
					8.00			

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level 		REMARKS No Groundwater Encountered Scale: 1:50	Water Strikes																																
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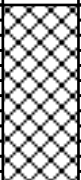
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			Project Number: 10/2197		Client: Twycross Zoo - East Midlands Zoological Society						
			GL (mAOD):		N Coord: 0		E Coord: 0				
Date: 09/09/2024			Method:		Driller:		Logged By: SRP				
Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe			
0.50	ES	N=13				MADE GROUND: Grass over reddish light grey slightly gravelly clayey fine coarse sand. Gravel is angular fine to coarse of chert and mudstone.					
					0.90 1.00	Grass over dark reddish brown grey slightly gravelly clayey fine coarse sand. Gravel is angular fine to coarse of chert and mudstone. (Glaciofluvial Deposits)					
					1.40	Firm to stiff red CLAY. (Thrussington Member)					
	D	N=13			2.00						
											
											
											
											
3.00		N=8			3.00						
				3.45							
					Stiff grey CLAY. (Thrussington Member)						
				4.00							
				4.40	End Of Borehole At 4.40 m						
		pp 50/250mm									
				5.00							
											
				6.00							
											
					7.00						
											
					8.00						
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa ▽ - Groundwater Strike ▼ - Groundwater Level 			REMARKS No Groundwater Encountered Scale: 1:50			Water Strikes					
						Date	Strike	Level	Minutes	Casing	Sealed
						Daily Log Of Depths			Chiselling		
						Date	Casing	Water	From	To	Hours

			Project Title: Twycross Zoo				WS02				
			Project Number: 10/2197		Client: Twycross Zoo - East Midlands Zoological Society						
			GL (mAOD):		N Coord: 0		E Coord: 0				
Date: 09/09/2024			Method:		Driller:		Logged By: SRP				
Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe			
					0.40	MADE GROUND: Reddish light grey slightly gravelly clayey fine to coarse sand. Gravel is angular fine to coarse of chert and mudstone					
		N=32			1.00 1.10	Reddish brown slightly clayey fine to coarse sandy angular to sub-angular fine to coarse gravel of mudstone and chert. (Glaciofluvial Deposits)					
		N=26			2.00 2.30	Firm to stiff red mottled cream CLAY. (Thrussington Member)					
		N=23			2.90 3.00	Stiff greyish cream CLAY. (Thrussington Member)					
		N=28			4.00	Firm red slightly sandy CLAY. Sand is fine to coarse. (Thrussington Member)					
		pp 50/190mm			4.50 4.70	Stiff grey CLAY. (Thrussington Member)					
					5.00	End Of Borehole At 4.70 m					
					6.00						
					7.00						
					8.00						
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level 			REMARKS No Groundwater Encountered Scale: 1:50			Water Strikes					
						Date	Strike	Level	Minutes	Casing	Sealed
						Daily Log Of Depths			Chiselling		
						Date	Casing	Water	From	To	Hours

			Project Title: Twycross Zoo				WS03				
			Project Number: 10/2197		Client: Twycross Zoo - East Midlands Zoological Society						
			GL (mAOD):		N Coord: 0		E Coord: 0				
Date: 10/09/2024			Method:		Driller:		Logged By: SRP				
Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe			
		N=43			0.20	MADE GROUND: Grass over dark greyish brown sandy gravel. Sand is fine to coarse. Gravel is angular to sub-angular fine to coarse of chert mudstone, sandstone and limestone. Dark reddish brown slightly clayey gravelly fine to coarse sand. Gravel is sub-angular fine to coarse of chert and mudstone. (Glaciofluvial Deposits) Firm red sandy CLAY. Sand is fine to coarse. (Thrussington Member)					
		N=19			1.00 1.15						
		N=13			2.00						
		pp 50/205mm			3.00 4.00						
						End Of Borehole At 4.00 m					
					5.00						
					6.00						
					7.00						
					8.00						
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level 			REMARKS No Groundwater Encountered Scale: 1:50			Water Strikes					
						Date	Strike	Level	Minutes	Casing	Sealed
						Daily Log Of Depths			Chiselling		
						Date	Casing	Water	From	To	Hours

		Project Title: Twycross Zoo				WS04		
		Project Number: 10/2197		Client: Twycross Zoo - East Midlands Zoological Society				
		GL (mAOD):		N Coord: 0		E Coord: 0		
Date: 10/09/2024		Method:		Driller:		Logged By: SRP		
Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.70	ES	N=15			0.20	MADE GROUND: Grass over brown slightly gravelly clayey sand. Sand is fine to coarse. Gravel is angular to sub-angular fine to coarse of chert and mudstone with rare coal.		
		N=9			1.00	Dark reddish brown slightly clayey gravelly fine to coarse sand. Gravel is sub-angular fine to coarse of chert and mudstone. (Glaciofluvial Deposits)		
		N=32			2.00	Firm red mottled grey sandy CLAY. (Thrussington Member)		
3.70	D	pp 50/220mm			2.80	Firm to stiff red mottled grey CLAY. (Thrussington Member)		
					3.00	Firm whiteish grey CLAY. (Thrussington Member)		
					3.40	End Of Borehole At 3.70 m		
					3.70			
					4.00			
					5.00			
					6.00			
					7.00			
					8.00			
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa ▽ - Groundwater Strike ▼ - Groundwater Level 			REMARKS No Groundwater Encountered Scale: 1:50			Water Strikes		
						Date	Strike	Level
						Daily Log Of Depths		
						Date	Casing	Water

			Project Title: Twycross Zoo				WS07					
			Project Number: 10/2197		Client: Twycross Zoo - East Midlands Zoological Society							
			GL (mAOD):		N Coord: 0		E Coord: 0					
Date: 10/09/2024			Method:		Driller:		Logged By: SRP					
Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe				
0.90	ES	N=13			0.40	MADE GROUND: Light greyish brown slightly clayey gravelly fine to coarse sand. Gravel is sub-angular to sub-rounded fine to coarse of chert and mudstone.						
					0.80							
5.00	D	N=20			1.00	MADE GROUND: Light reddish brown slightly clayey gravelly fine to coarse sand. Gravel is sub-angular to sub-rounded fine to coarse of chert and mudstone.						
					1.20							
					2.00	Dark brown slightly gravelly clayey fine to coarse sand. Gravel is angular to sub-angular fine to coarse of chert. (Glaciofluvial Deposits)						
					3.00							
					4.00	Medium dense orangeish red silty fine to medium SAND. (Thrussington Member)						
					5.00							
					End Of Borehole At 5.00 m							
					6.00							
					7.00							
					8.00							
KEY			REMARKS			Water Strikes						
D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa ▽ - Groundwater Strike ▼ - Groundwater Level						Date	Strike	Level	Minutes	Casing	Sealed	
			Scale: 1:50			10/09/2024 2.3						
						Daily Log Of Depths			Chiselling			
						Date	Casing	Water	From	To	Hours	

			Project Title: Twycross Zoo				WS08				
			Project Number: 10/2197		Client: Twycross Zoo - East Midlands Zoological Society						
			GL (mAOD):		N Coord: 0		E Coord: 0				
Date: 09/09/2024			Method:		Driller:		Logged By: SRP				
Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe			
		pp 50/255mm			1.00	MADE GROUND: Dark brown slightly clayey gravelly fine to coarse sand. Gravel is sub-angular fine to coarse of chert, limestone and mudstone. End Of Borehole At 1.20 m					
					1.20						
					2.00						
					3.00						
					4.00						
					5.00						
					6.00						
					7.00						
					8.00						
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa ▽ - Groundwater Strike ▼ - Groundwater Level 			REMARKS No Groundwater Encountered Scale: 1:50			Water Strikes					
						Date	Strike	Level	Minutes	Casing	Sealed
						Daily Log Of Depths			Chiselling		
						Date	Casing	Water	From	To	Hours

			Project Title: Twycross Zoo			TP01		
			Project Number: 10/2197		Client: Twycross Zoo - East Midlands Zoological Society			
			GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 11/09/2023-12/09/2023			Method:		Logged By: SRP		Scale: 1:50	
Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	
0.30	ES				0.30	MADE GROUND: Dark brown/ red slightly gravelly clayey fine to coarse sand. Gravel is angular to sub-rounded fine to medium of mudstone.		
					1.00	Red/ brown slightly gravelly clayey fine to coarse SAND. Gravel is sub-rounded fine to medium of mudstone.		
					2.00	End Of Trial Pit At 2.00 m		
					3.00			
					4.00			
					5.00			
					6.00			
					7.00			
					8.00			
					9.00			
					10.00			
KEY D - Disturbed Sample B - Bulk Sample W - Water Sample V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level 						REMARKS No Groundwater Encountered		

			Project Title: Twycross Zoo			TP02		
			Project Number: 10/2197		Client: Twycross Zoo - East Midlands		Shedding Society	
			GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 11/09/2023-12/09/2023			Method:		Logged By: SRP		Scale: 1:50	
Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	
0.60	ES				0.45	MADE GROUND: Dark brown slightly gravelly sandy clay. Sand is fine to coarse. Gravel is sub-angular to sub-rounded fine to coarse of mudstone.		
					1.00	Soft to firm red/ brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is sub-angular to sub-rounded fine to coarse of mudstone.		
					2.00	End Of Trial Pit At 2.00 m		
					3.00			
					4.00			
					5.00			
					6.00			
					7.00			
					8.00			
					9.00			
					10.00			
KEY D - Disturbed Sample B - Bulk Sample W - Water Sample V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level 					REMARKS No Groundwater Encountered			

APPENDIX III
CHEMICAL LABORATORY TEST RESULTS

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 23/09279
Issue Number: 1

Date: 10 October, 2023

Client: Clancy Consulting
Dunham Court
2 Dunham Road
Altrincham
Cheshire
UK
WA14 4NX

Project Manager: Robert Philip
Project Name: Twycross Zoo
Project Ref: Oct-97
Order No: 32905
Date Samples Received: 18/09/23
Date Instructions Received: 20/09/23
Date Analysis Completed: 10/10/23

Approved by:



Gemma Berrisford
Deputy Client Services Supervisor

Envirolab Job Number: 23/09279

Client Project Name: Twycross Zoo

Client Project Ref: Oct-97

Lab Sample ID	23/09279/1	23/09279/2	23/09279/3	23/09279/4	23/09279/5	23/09279/6	23/09279/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH01	WS01	WS01	TP01	TP02	BH03	BH04			
Depth to Top	0.50	0.30	1.00	0.30	0.60	0.10	0.70			
Depth To Bottom										
Date Sampled	06-Sep-23	11-Sep-23	11-Sep-23	11-Sep-23	11-Sep-23	12-Sep-23	12-Sep-23			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	5A	5AE	5A	5A	5A	4AE	5A			
% Stones >10mm _A	10.4	6.7	21.6	<0.1	<0.1	16.6	<0.1	% w/w	0.1	A-T-044
pH _D ^{M#}	7.88	7.21	6.98	6.75	7.51	7.51	7.79	pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.03	g/l	0.01	A-T-026s
Arsenic _D ^{M#}	4	2	5	2	<1	3	2	mg/kg	1	A-T-024s
Boron (water soluble) _D ^{M#}	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	mg/kg	1	A-T-027s
Cadmium _D ^{M#}	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	mg/kg	0.5	A-T-024s
Copper _D ^{M#}	15	10	16	10	17	12	15	mg/kg	1	A-T-024s
Chromium _D ^{M#}	13	15	12	17	41	13	14	mg/kg	1	A-T-024s
Lead _D ^{M#}	16	13	30	17	7	21	155	mg/kg	1	A-T-024s
Mercury _D	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	10	10	12	13	35	13	11	mg/kg	1	A-T-024s
Selenium _D ^{M#}	<1	<1	<1	<1	<1	<1	<1	mg/kg	1	A-T-024s
Zinc _D ^{M#}	37	33	47	37	54	37	35	mg/kg	5	A-T-024s

Envirolab Job Number: 23/09279

Client Project Name: Twycross Zoo

Client Project Ref: Oct-97

Lab Sample ID	23/09279/1	23/09279/2	23/09279/3	23/09279/4	23/09279/5	23/09279/6	23/09279/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH01	WS01	WS01	TP01	TP02	BH03	BH04			
Depth to Top	0.50	0.30	1.00	0.30	0.60	0.10	0.70			
Depth To Bottom										
Date Sampled	06-Sep-23	11-Sep-23	11-Sep-23	11-Sep-23	11-Sep-23	12-Sep-23	12-Sep-23			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	5A	5AE	5A	5A	5A	4AE	5A			
Asbestos in Soil (inc. matrix)										
Asbestos in soil _D [#]	NAD	NAD	-	NAD	-	NAD	-			A-T-045
Asbestos Matrix (visual) _D	-	-	-	-	-	-	-			A-T-045
Asbestos Matrix (microscope) _D	-	-	-	-	-	-	-			A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	N/A	N/A	-	N/A	-	N/A	-			A-T-045

Envirolab Job Number: 23/09279

Client Project Name: Twycross Zoo

Client Project Ref: Oct-97

Lab Sample ID	23/09279/1	23/09279/2	23/09279/3	23/09279/4	23/09279/5	23/09279/6	23/09279/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH01	WS01	WS01	TP01	TP02	BH03	BH04			
Depth to Top	0.50	0.30	1.00	0.30	0.60	0.10	0.70			
Depth To Bottom										
Date Sampled	06-Sep-23	11-Sep-23	11-Sep-23	11-Sep-23	11-Sep-23	12-Sep-23	12-Sep-23			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	5A	5AE	5A	5A	5A	4AE	5A			
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	0.04	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	0.07	A-T-019s
Total PAH-16MS _A	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	mg/kg	0.01	A-T-019s

Envirolab Job Number: 23/09279

Client Project Name: Twycross Zoo

Client Project Ref: Oct-97

Lab Sample ID	23/09279/1	23/09279/2	23/09279/3	23/09279/4	23/09279/5	23/09279/6	23/09279/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH01	WS01	WS01	TP01	TP02	BH03	BH04			
Depth to Top	0.50	0.30	1.00	0.30	0.60	0.10	0.70			
Depth To Bottom										
Date Sampled	06-Sep-23	11-Sep-23	11-Sep-23	11-Sep-23	11-Sep-23	12-Sep-23	12-Sep-23			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	5A	5AE	5A	5A	5A	4AE	5A			
TPH CWG with Clean Up										
Ali >C5-C6 _A	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
Ali >C6-C8 _A	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
Ali >C8-C10 _A	<1	<1	-	<1	-	<1	-	mg/kg	1	A-T-055s
Ali >C10-C12 _A ^{M#}	<1	<1	-	<1	-	<1	-	mg/kg	1	A-T-055s
Ali >C12-C16 _A ^{M#}	<1	<1	-	<1	-	<1	-	mg/kg	1	A-T-055s
Ali >C16-C21 _A ^{M#}	<1	<1	-	<1	-	<1	-	mg/kg	1	A-T-055s
Ali >C21-C35 _A ^{M#}	3	2	-	1	-	7	-	mg/kg	1	A-T-055s
Total Aliphatics _A	3	2	-	1	-	7	-	mg/kg	1	Calc-As Recd
Aro >C5-C7 _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
Aro >C8-C10 _A	<1	<1	-	<1	-	<1	-	mg/kg	1	A-T-055s
Aro >C10-C12 _A	<1	<1	-	<1	-	<1	-	mg/kg	1	A-T-055s
Aro >C12-C16 _A ^{M#}	<1	<1	-	<1	-	<1	-	mg/kg	1	A-T-055s
Aro >C16-C21 _A ^{M#}	2	<1	-	<1	-	<1	-	mg/kg	1	A-T-055s
Aro >C21-C35 _A ^{M#}	6	1	-	<1	-	<1	-	mg/kg	1	A-T-055s
Total Aromatics _A	8	1	-	<1	-	<1	-	mg/kg	1	Calc-As Recd
TPH (Ali & Aro >C5-C35) _A	11	3	-	1	-	8	-	mg/kg	1	Calc-As Recd
BTEX - Benzene _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s
MTBE _A [#]	<0.01	<0.01	-	<0.01	-	<0.01	-	mg/kg	0.01	A-T-022s

Envirolab Job Number: 23/09279

Client Project Name: Twycross Zoo

Client Project Ref: Oct-97

Lab Sample ID	23/09279/8	23/09279/9	23/09279/10	23/09279/11	23/09279/14	23/09279/16	23/09279/17	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH02	BH01	BH01	BH01	BH01	BH02	BH02			
Depth to Top	0.20	1.2	2.0	3.0	7.0	2.0	3.0			
Depth To Bottom	0.30									
Date Sampled	12-Sep-23	06-Sep-23	07-Sep-23	07-Sep-23	07-Sep-23	12-Sep-23	12-Sep-23			
Sample Type	SOIL - ES	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D			
Sample Matrix Code	5A			3	6A					
% Stones >10mm _A	<0.1	-	-	<0.1	<0.1	-	-	% w/w	0.1	A-T-044
pH _D ^{M#}	7.77	-	-	7.54	8.40	-	-	pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.02	-	-	0.03	0.04	-	-	g/l	0.01	A-T-026s
Arsenic _D ^{M#}	1	-	-	-	-	-	-	mg/kg	1	A-T-024s
Boron (water soluble) _D ^{M#}	<1.0	-	-	-	-	-	-	mg/kg	1	A-T-027s
Cadmium _D ^{M#}	<0.5	-	-	-	-	-	-	mg/kg	0.5	A-T-024s
Copper _D ^{M#}	15	-	-	-	-	-	-	mg/kg	1	A-T-024s
Chromium _D ^{M#}	21	-	-	-	-	-	-	mg/kg	1	A-T-024s
Lead _D ^{M#}	22	-	-	-	-	-	-	mg/kg	1	A-T-024s
Mercury _D	<0.17	-	-	-	-	-	-	mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	15	-	-	-	-	-	-	mg/kg	1	A-T-024s
Selenium _D ^{M#}	<1	-	-	-	-	-	-	mg/kg	1	A-T-024s
Zinc _D ^{M#}	52	-	-	-	-	-	-	mg/kg	5	A-T-024s
(1.10a) Item 12a Particle Size Distribution (Wet Sieving Method) _A [#]	-	-	Appended	-	-	-	Appended			Subcon IFA
(1.03) Item 2a 1 point Liquid & Plastic Limit by Cone Penetrometer _A [#]	-	Appended	-	-	Appended	Appended	-			Subcon IFA
(1.01) Item 1a Moisture Content of Soil (Oven Dried Method) _A [#]	-	Appended	-	-	Appended	Appended	-			Subcon IFA

Envirolab Job Number: 23/09279

Client Project Name: Twycross Zoo

Client Project Ref: Oct-97

Lab Sample ID	23/09279/8	23/09279/9	23/09279/10	23/09279/11	23/09279/14	23/09279/16	23/09279/17	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH02	BH01	BH01	BH01	BH01	BH02	BH02			
Depth to Top	0.20	1.2	2.0	3.0	7.0	2.0	3.0			
Depth To Bottom	0.30									
Date Sampled	12-Sep-23	06-Sep-23	07-Sep-23	07-Sep-23	07-Sep-23	12-Sep-23	12-Sep-23			
Sample Type	SOIL - ES	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D			
Sample Matrix Code	5A			3	6A					
Asbestos in Soil (inc. matrix)										
Asbestos in soil _D [#]	NAD	-	-	-	-	-	-			A-T-045
Asbestos Matrix (visual) _D	-	-	-	-	-	-	-			A-T-045
Asbestos Matrix (microscope) _D	-	-	-	-	-	-	-			A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	N/A	-	-	-	-	-	-			A-T-045

Envirolab Job Number: 23/09279

Client Project Name: Twycross Zoo

Client Project Ref: Oct-97

Lab Sample ID	23/09279/8	23/09279/9	23/09279/10	23/09279/11	23/09279/14	23/09279/16	23/09279/17	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH02	BH01	BH01	BH01	BH01	BH02	BH02			
Depth to Top	0.20	1.2	2.0	3.0	7.0	2.0	3.0			
Depth To Bottom	0.30									
Date Sampled	12-Sep-23	06-Sep-23	07-Sep-23	07-Sep-23	07-Sep-23	12-Sep-23	12-Sep-23			
Sample Type	SOIL - ES	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D			
Sample Matrix Code	5A			3	6A					
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	<0.02	-	-	-	-	-	-	mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	-	-	-	-	-	-	mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	-	-	-	-	-	-	mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	<0.05	-	-	-	-	-	-	mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	-	-	-	-	-	-	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	-	-	-	-	-	-	mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	<0.06	-	-	-	-	-	-	mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A	<0.04	-	-	-	-	-	-	mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	0.11	-	-	-	-	-	-	mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	-	-	-	-	-	-	mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	<0.03	-	-	-	-	-	-	mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	0.10	-	-	-	-	-	-	mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	0.10	-	-	-	-	-	-	mg/kg	0.07	A-T-019s
Total PAH-16MS _A	0.31	-	-	-	-	-	-	mg/kg	0.01	A-T-019s

Envirolab Job Number: 23/09279

Client Project Name: Twycross Zoo

Client Project Ref: Oct-97

Lab Sample ID	23/09279/8	23/09279/9	23/09279/10	23/09279/11	23/09279/14	23/09279/16	23/09279/17	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH02	BH01	BH01	BH01	BH01	BH02	BH02			
Depth to Top	0.20	1.2	2.0	3.0	7.0	2.0	3.0			
Depth To Bottom	0.30									
Date Sampled	12-Sep-23	06-Sep-23	07-Sep-23	07-Sep-23	07-Sep-23	12-Sep-23	12-Sep-23			
Sample Type	SOIL - ES	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D			
Sample Matrix Code	5A			3	6A					
TPH CWG with Clean Up										
Ali >C5-C6 _A	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-022s
Ali >C6-C8 _A	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-022s
Ali >C8-C10 _A	<1	-	-	-	-	-	-	mg/kg	1	A-T-055s
Ali >C10-C12 _A ^{M#}	<1	-	-	-	-	-	-	mg/kg	1	A-T-055s
Ali >C12-C16 _A ^{M#}	<1	-	-	-	-	-	-	mg/kg	1	A-T-055s
Ali >C16-C21 _A ^{M#}	<1	-	-	-	-	-	-	mg/kg	1	A-T-055s
Ali >C21-C35 _A ^{M#}	8	-	-	-	-	-	-	mg/kg	1	A-T-055s
Total Aliphatics _A	8	-	-	-	-	-	-	mg/kg	1	Calc-As Recd
Aro >C5-C7 _A [#]	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-022s
Aro >C7-C8 _A [#]	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-022s
Aro >C8-C10 _A	<1	-	-	-	-	-	-	mg/kg	1	A-T-055s
Aro >C10-C12 _A	<1	-	-	-	-	-	-	mg/kg	1	A-T-055s
Aro >C12-C16 _A ^{M#}	<1	-	-	-	-	-	-	mg/kg	1	A-T-055s
Aro >C16-C21 _A ^{M#}	<1	-	-	-	-	-	-	mg/kg	1	A-T-055s
Aro >C21-C35 _A ^{M#}	2	-	-	-	-	-	-	mg/kg	1	A-T-055s
Total Aromatics _A	2	-	-	-	-	-	-	mg/kg	1	Calc-As Recd
TPH (Ali & Aro >C5-C35) _A	10	-	-	-	-	-	-	mg/kg	1	Calc-As Recd
BTEX - Benzene _A [#]	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-022s
BTEX - Toluene _A [#]	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-022s
BTEX - o Xylene _A [#]	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-022s
MTBE _A [#]	<0.01	-	-	-	-	-	-	mg/kg	0.01	A-T-022s

Envirolab Job Number: 23/09279

Client Project Name: Twycross Zoo

Client Project Ref: Oct-97

Lab Sample ID	23/09279/18	23/09279/19	23/09279/21	23/09279/22	23/09279/24	23/09279/25	23/09279/28	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH02	BH02	BH03	BH03	BH03	BH03	BH04			
Depth to Top	4.0	5.0	1.5	2.0	4.0	5.0	2.0			
Depth To Bottom										
Date Sampled	12-Sep-23	12-Sep-23	12-Sep-23	12-Sep-23	12-Sep-23	12-Sep-23	12-Sep-23			
Sample Type	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D			
Sample Matrix Code		6A	5A							
% Stones >10mm _A	-	<0.1	13.5	-	-	-	-	% w/w	0.1	A-T-044
pH _D ^{M#}	-	7.25	7.18	-	-	-	-	pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	-	0.03	0.03	-	-	-	-	g/l	0.01	A-T-026s
(1.10a) Item 12a Particle Size Distribution (Wet Sieving Method) _A [#]	-	-	-	-	-	Appended	Appended			Subcon IFA
(1.03) Item 2a 1 point Liquid & Plastic Limit by Cone Penetrometer _A [#]	Appended	-	-	Appended	Appended	-	-			Subcon IFA
(1.01) Item 1a Moisture Content of Soil (Oven Dried Method) _A [#]	Appended	-	-	Appended	Appended	-	-			Subcon IFA

Envirolab Job Number: 23/09279

Client Project Name: Twycross Zoo

Client Project Ref: Oct-97

Lab Sample ID	23/09279/29	23/09279/30	23/09279/31	23/09279/32	23/09279/33	23/09279/34	23/09279/35	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH04	BH04	BH04	WS05	WS05	WS05	WS05			
Depth to Top	3.0	4.0	5.0	1.2	2.0	3.0	4.0			
Depth To Bottom										
Date Sampled	12-Sep-23	12-Sep-23	12-Sep-23	12-Sep-23	12-Sep-23	12-Sep-23	12-Sep-23			
Sample Type	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D			
Sample Matrix Code		3			3					
% Stones >10mm _A	-	<0.1	-	-	<0.1	-	-	% w/w	0.1	A-T-044
pH _D ^{M#}	-	7.17	-	-	7.29	-	-	pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	-	0.04	-	-	<0.01	-	-	g/l	0.01	A-T-026s
(1.10a) Item 12a Particle Size Distribution (Wet Sieving Method) _A [#]	-	-	-	-	-	-	Appended			Subcon IFA
(1.03) Item 2a 1 point Liquid & Plastic Limit by Cone Penetrometer _A [#]	Appended	-	Appended	Appended	-	Appended	-			Subcon IFA
(1.01) Item 1a Moisture Content of Soil (Oven Dried Method) _A [#]	Appended	-	Appended	Appended	-	Appended	-			Subcon IFA

Report Notes

General

This report shall not be reproduced, except in full, without written approval from Envirolab.
 The results reported herein relate only to the material supplied to the laboratory.
 The residue of any samples contained within this report, and any received within the same delivery, will be disposed of **six weeks** after the initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of **six months** after the initial Asbestos testing is completed.
 Analytical results reflect the quality of the sample at the time of analysis only.
 Opinions and Interpretations expressed are outside our scope of accreditation.
 The client Sample No, Client Sample ID, Depth to top, Depth to Bottom and Date Sampled are all provided by the client.
 A deviating sample report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Key

Superscript "#"	Accredited to ISO 17025
Superscript "M"	Accredited to MCertS
Superscript "U"	Individual result not accredited
None of the above symbols	Analysis unaccredited
Subscript "A"	Analysis performed on as-received Sample
Subscript "D"	Analysis performed on the dried sample, crushed to pass 2mm sieve.
Subscript "A"	Analysis has dependant options against results. Details appear in the comments of your Sample receipt
IS	Insufficient Sample for analysis
US	Unsuitable Sample for analysis
NDP	No Determination Possible
NAD	No Asbestos Detected
N/A	Not applicable

Asbestos

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
 Stones etc. are not removed from the sample prior to analysis
 Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing, and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Assigned Matrix Codes

1	SAND	6	CLAY/LOAM	A	Contains Stones
2	LOAM	7	OTHER	B	Contains Construction Rubble
3	CLAY	8	Asbestos Bulk (Only Asbestos ID accredited)	C	Contains visible hydrocarbons
4	LOAM/SAND	9	Incinerator Ash (some Metals accredited)	D	Contains glass / metal
5	SAND/CLAY			E	Contains roots / twigs

Note: 7,8,9 matrices are not covered by our ISO 17025 or MCertS accreditation, unless stated above.

Soil Chemical Analysis:

All results are reported as dry weight (<40°C).
 For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
 For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts
 All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH by method A-T-007:

For waters, free and visible oils are excluded from the sample used for analysis, so the reported result represents the dissolved phase only.
 Results "with Clean up" indicates samples cleaned up with Silica during extraction.

EPH CWG (method A-T-055) from TPH CWG:

EPH CWG results have humics mathematically subtracted through instrument calculation.
 Where these humic substances have been identified in any IDs from "TPH CWG with clean up" please note that the concentration is **NOT** included in the quantified results but present in the ID for information.

Electrical Conductivity of water by method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the accreditation range and as such are unaccredited.

Please contact your client manager if you require any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Clancy Consulting, Dunham Court, 2 Dunham Road, Altrincham, Cheshire, UK, WA14 4NX
Project: Twycross Zoo
Clients Project No: Oct-97
Project No: 23/09279
Date Received: 20/09/2023 (am)
Cool Box Temperatures (°C): 16.5-17.2

Lab Sample ID	23/09279/1
Client Sample No	
Client Sample ID/Depth	BH01 0.50m
Date Sampled	06/09/23
Deviation Code	
F	✓

Key

F Maximum holding time exceeded between sampling date and analysis for analytes listed below

HOLDING TIME EXCEEDANCES

Lab Sample ID	23/09279/1
Client Sample No	
Client Sample ID/Depth	BH01 0.50m
Date Sampled	06/09/23
PAH-16MS	✓
VPHCWG	✓

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	23/09279/1	23/09279/2	23/09279/3	23/09279/4	23/09279/5	23/09279/6	23/09279/7	23/09279/8	23/09279/9	23/09279/10	23/09279/11	23/09279/14
Client Sample No												
Client Sample ID/Depth	BH01 0.50m	WS01 0.30m	WS01 1.00m	TP01 0.30m	TP02 0.60m	BH03 0.10m	BH04 0.70m	BH02 0.20-0.30m	BH01 1.2m	BH01 2.0m	BH01 3.0m	BH01 7.0m
Date Sampled	06/09/23	11/09/23	11/09/23	11/09/23	11/09/23	12/09/23	12/09/23	12/09/23	06/09/23	07/09/23	07/09/23	07/09/23
A-T-019s	26/09/2023	26/09/2023	26/09/2023	26/09/2023	26/09/2023	26/09/2023	26/09/2023	26/09/2023				
A-T-022s	26/09/2023	26/09/2023		26/09/2023		26/09/2023		26/09/2023				
A-T-024s	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023				
A-T-026s	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023			29/09/2023	29/09/2023
A-T-027s	27/09/2023	27/09/2023	27/09/2023	27/09/2023	27/09/2023	27/09/2023	27/09/2023	27/09/2023				
A-T-031s	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023			29/09/2023	29/09/2023
A-T-044	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023	28/09/2023			28/09/2023	28/09/2023
A-T-045	21/09/2023	21/09/2023		21/09/2023		21/09/2023		21/09/2023				
A-T-055s	25/09/2023	25/09/2023		25/09/2023		25/09/2023		25/09/2023				
Calc-As Recd	26/09/2023	26/09/2023		26/09/2023		26/09/2023		26/09/2023				

Lab Sample ID	23/09279/16	23/09279/17	23/09279/18	23/09279/19	23/09279/21	23/09279/22	23/09279/24	23/09279/25	23/09279/28	23/09279/29	23/09279/30	23/09279/31
Client Sample No												
Client Sample ID/Depth	BH02 2.0m	BH02 3.0m	BH02 4.0m	BH02 5.0m	BH03 1.5m	BH03 2.0m	BH03 4.0m	BH03 5.0m	BH04 2.0m	BH04 3.0m	BH04 4.0m	BH04 5.0m
Date Sampled	12/09/23	12/09/23	12/09/23	12/09/23	12/09/23	12/09/23	12/09/23	12/09/23	12/09/23	12/09/23	12/09/23	12/09/23
A-T-019s												
A-T-022s												
A-T-024s												
A-T-026s				29/09/2023	29/09/2023						29/09/2023	
A-T-027s												
A-T-031s				29/09/2023	29/09/2023						29/09/2023	
A-T-044				28/09/2023	28/09/2023						28/09/2023	
A-T-045												
A-T-055s												
Calc-As Recd												

Lab Sample ID	23/09279/32	23/09279/33	23/09279/34	23/09279/35
Client Sample No				
Client Sample ID/Depth	WS05 1.2m	WS05 2.0m	WS05 3.0m	WS05 4.0m
Date Sampled	12/09/23	12/09/23	12/09/23	12/09/23
A-T-019s				
A-T-022s				
A-T-024s				
A-T-026s		29/09/2023		
A-T-027s				
A-T-031s		29/09/2023		
A-T-044		28/09/2023		
A-T-045				
A-T-055s				
Calc-As Recd				

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

Clancy Consulting
Dunham Court
2 Dunham Road
Altrincham

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e: sophie.piercy@clancy.co.uk

i2 Analytical Ltd.
7 Woodshots Meadow,
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WD18 8YS

t: 01923 225404

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e: reception@i2analytical.com

Analytical Report Number : 24-042985

Project / Site name:	Twycross Zoo	Samples received on:	18/09/2024
Your job number:	10 2197	Samples instructed on/ Analysis started on:	19/09/2024
Your order number:	34550	Analysis completed by:	27/09/2024
Report Issue Number:	1	Report issued on:	30/09/2024
Samples Analysed:	2 soil samples		

Signed:



Claire Bancroft
Customer Service Advisor
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 24-042985

Project / Site name: Twycross Zoo

Your Order No: 34550

Lab Sample Number				321331	321332
Sample Reference				WS01	WS04
Sample Number				None Supplied	None Supplied
Depth (m)				0.50	0.70
Date Sampled				09/09/2024	09/09/2024
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status		

Stone Content	%	0.1	NONE	42.3	10.2
Moisture Content	%	0.01	NONE	3.1	9.2
Total mass of sample received	kg	0.1	NONE	0.8	0.8

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	DBU	DBU

General Inorganics

pH (L099)	pH Units	N/A	MCERTS	8	7.3
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	38	47
Water Soluble SO ₄ 16hr extraction (2:1)	mg/l	1.25	MCERTS	19	23.4

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.07
Pyrene	mg/kg	0.05	MCERTS	< 0.05	0.07
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	< 0.80	< 0.80
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	6.5	7.7
Barium (aqua regia extractable)	mg/kg	1	MCERTS	100	61
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.39	0.7
Boron (water soluble)	mg/kg	0.2	MCERTS	0.4	0.7
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	2	0.3
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	12	18
Copper (aqua regia extractable)	mg/kg	1	MCERTS	10	18
Lead (aqua regia extractable)	mg/kg	1	MCERTS	20	38
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	8.6	15
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	19	25
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	160	63

Analytical Report Number: 24-042985

Project / Site name: Twycross Zoo

Your Order No: 34550

Lab Sample Number				321331	321332
Sample Reference				WS01	WS04
Sample Number				None Supplied	None Supplied
Depth (m)				0.50	0.70
Date Sampled				09/09/2024	09/09/2024
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Test Limit of detection
				Test Accreditation Status	

Petroleum Hydrocarbons

TPHCWG - Aliphatic >EC5 - EC6 _{HS_1D_AL}	mg/kg	0.01	MCERTS	< 0.010	< 0.010
TPHCWG - Aliphatic >EC6 - EC8 _{HS_1D_AL}	mg/kg	0.01	MCERTS	< 0.010	< 0.010
TPHCWG - Aliphatic >EC8 - EC10 _{HS_1D_AL}	mg/kg	0.01	MCERTS	< 0.010	< 0.010
TPHCWG - Aliphatic >EC10 - EC12 _{EH_CU_1D_AL}	mg/kg	1	MCERTS	< 1.0	< 1.0
TPHCWG - Aliphatic >EC12 - EC16 _{EH_CU_1D_AL}	mg/kg	2	MCERTS	< 2.0	< 2.0
TPHCWG - Aliphatic >EC16 - EC21 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	< 8.0	< 8.0
TPHCWG - Aliphatic >EC21 - EC35 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	< 8.0	< 8.0
TPHCWG - Aliphatic >EC5 - EC35 _{EH_CU+HS_1D_AL}	mg/kg	10	NONE	< 10	< 10

TPHCWG - Aromatic >EC5 - EC7 _{HS_1D_AR}	mg/kg	0.01	MCERTS	< 0.010	< 0.010
TPHCWG - Aromatic >EC7 - EC8 _{HS_1D_AR}	mg/kg	0.01	MCERTS	< 0.010	< 0.010
TPHCWG - Aromatic >EC8 - EC10 _{HS_1D_AR}	mg/kg	0.02	MCERTS	< 0.020	< 0.020
TPHCWG - Aromatic >EC10 - EC12 _{EH_CU_1D_AR}	mg/kg	1	MCERTS	< 1.0	< 1.0
TPHCWG - Aromatic >EC12 - EC16 _{EH_CU_1D_AR}	mg/kg	2	MCERTS	< 2.0	< 2.0
TPHCWG - Aromatic >EC16 - EC21 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	< 10
TPHCWG - Aromatic >EC21 - EC35 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	< 10
TPHCWG - Aromatic >EC5 - EC35 _{EH_CU+HS_1D_AR}	mg/kg	10	NONE	< 10	< 10

VOCs

MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0
o-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 24-042985

Project / Site name: Twycross Zoo

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
321331	WS01	None Supplied	0.5	Brown loam and sand with gravel and stones
321332	WS04	None Supplied	0.7	Brown loam and clay with stones and vegetation

Analytical Report Number : 24-042985

Project / Site name: Twycross Zoo

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in Soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques	In-house method based on HSG 248, 2021	A001B	D	ISO 17025
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L038B	D	MCERTS
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES	In-house method based on Second Site Properties version 3	L038B	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	L038B	D	MCERTS
Speciated PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L076B/L088-PL	D/W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method	L080-PL	W	MCERTS

Analytical Report Number : 24-042985

Project / Site name: Twycross Zoo

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099-PL	D	MCERTS

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
-	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Quality control parameter failure associated with individual result applies to calculated sum of individuals.

The result for sum should be interpreted with caution

APPENDIX IV
GEOTECHNICAL LABORATORY TEST RESULTS

F.A.O.

Final Test Report - 2281688 / 1

Site: Twycross 200

Job Number: 2281688

Originating Client: Envirolab

Originating Reference: 23/09279

Date Sampled: Not Given

Date Scheduled: 25/09/2023

Date Testing Started: 29/09/2023

Date Testing Finished: 10/10/2023

Previous Reports		Amendments	Date Issued

Amendments:

Authorised By:

Tim Robinson
Quality Supervisor

Report Issue Date: 10/10/2023



Site: Twycross 200

Job Number: 2281688

Client: Envirolab

Page: 2

**Determination of Moisture Content, Liquid Limit and Plastic Limit
and Derivation of Plasticity and Liquidity Index**

Borehole / Trial Pit	Depth (m)	Sample	Natural Moisture Content %	Natural - Stones removed by hand Sieved - Washed on 425 µm sieve			Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
				Natural / Sieved	Percentage Passing %	Moisture Content %						
BH01	1.20	D	9.4	Sieved	49	14		NP				Brown gravelly, silty SAND
BH01	7.00	D	17	Natural	97	17	35	23	12	-0.47	CL/CI	Brown silty CLAY
BH02	2.00	D	18	Sieved	76	22		19*				Brown sandy CLAY/GRAVEL
BH02	4.00	D	37	Natural	97	38	33	16	17	1.29	CL	Brown silty CLAY
BH03	2.00	D	18	Sieved	77	22	22	12	10	0.98	CL	Brown sandy, gravelly, silty CLAY
BH03	4.00	D	37	Natural	97	38	47	22	25	0.64	CI	Brown silty CLAY
BH04	3.00	D	20	Sieved	98	20	41	21	20	-0.03	CI	Brown silty CLAY
BH04	5.00	D	22	Natural	99	22	37	20	17	0.13	CI	Brown silty CLAY
WS05	1.20	D	13	Natural	99	13	27	13	14	0.01	CL	Brown slightly sandy, silty CLAY
WS05	3.00	D	30	Natural	96	31	45	23	22	0.36	CI	Brown silty CLAY

Method of Preparation: BS 1377 : Part 1 : 1990 : Clause 7 Preparation of disturbed samples for testing

BS 1377 : Part 1 : 2016 : Clause 8.4.3 Preparation of samples for plasticity tests

BS 1377 : Part 2 : 1990 : Clause 4.2 Preparation of samples for plastic limit tests

Method of Test: BS 1377 : Part 2 : 1990 : Clause 3.2 Determination of moisture content

BS 1377 : Part 2 : 1990 : Clause 4.3 or 4.4 Determination of the liquid limit

BS 1377 : Part 2 : 1990 : Clause 5.3 Determination of the plastic limit and plasticity index

*Insufficient sample. Plastic Limit tested only.

Results reported relate only to the samples tested.

1464

Site: Twycross 200

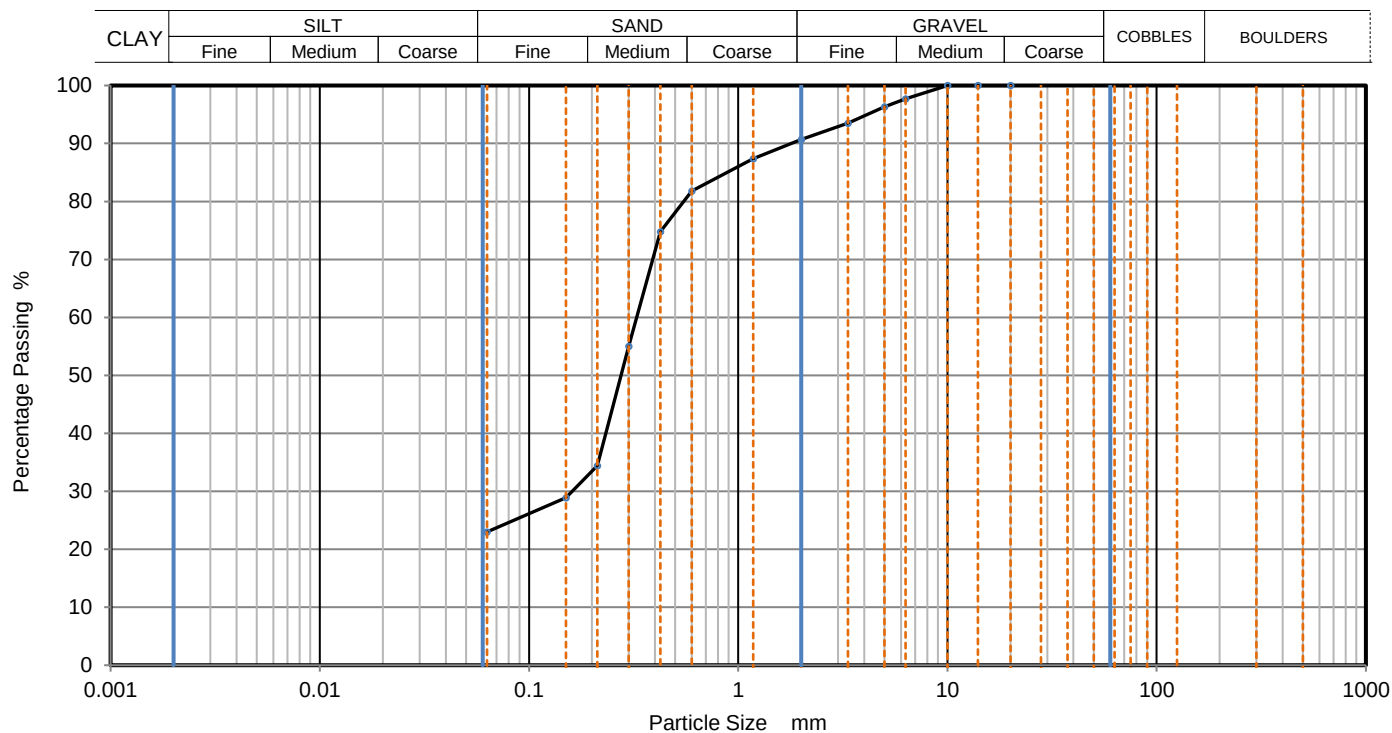
Job Number: 2281688

Client: Envirolab

Page: 3

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH01	2.00	D	Wet Sieve	Brown slightly gravelly, clayey, silty SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
20	100		
14	100		
10	100		
6.3	98		
5	96		
3.35	94		
2	91		
1.18	87		
0.6	82		
0.425	75		
0.3	55		
0.212	34		
0.15	29		
0.063	23		

Dry Mass of sample, g
599

Sample Proportions	% dry mass
Very coarse	0
Gravel	9
Sand	68
Fines <0.063mm	23

Grading Analysis		
D100	mm	10
D60	mm	0.327
D30	mm	0.161
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

Site: Twycross 200

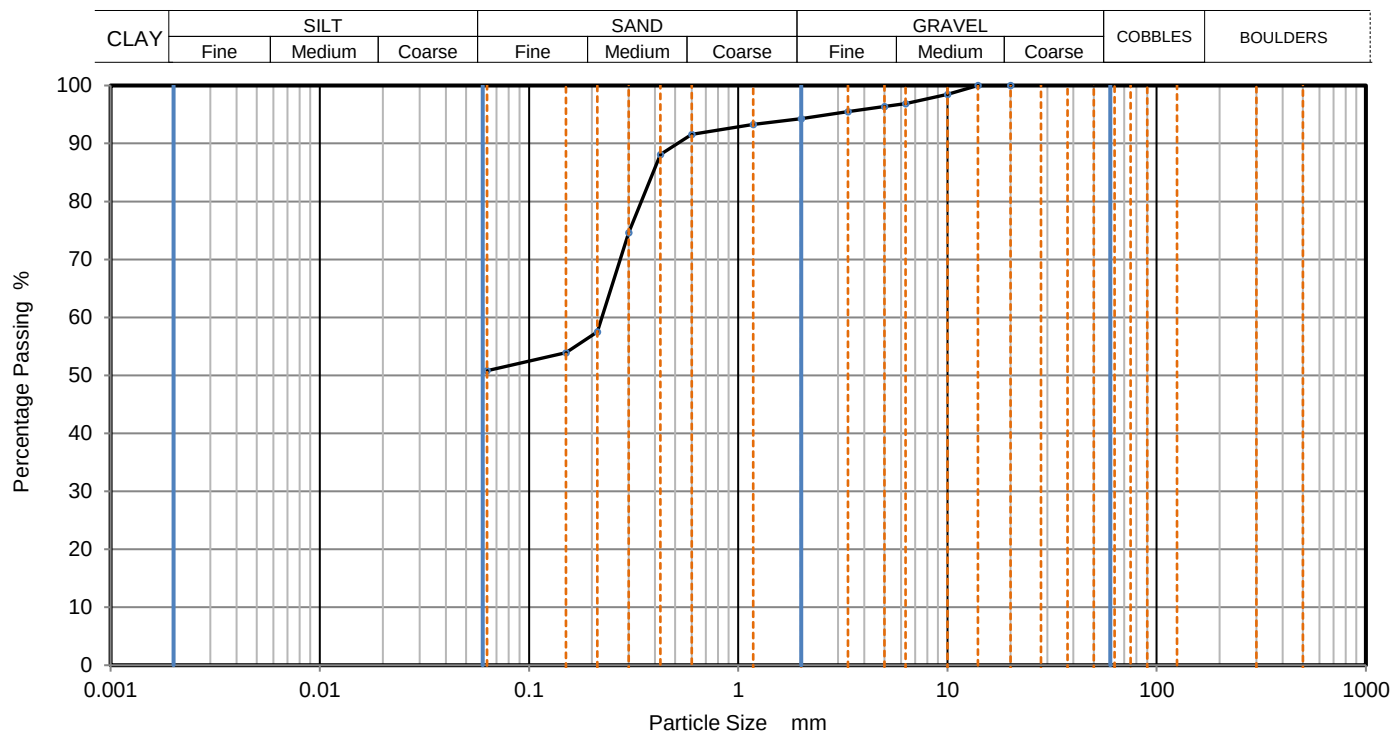
Job Number: 2281688

Client: Envirolab

Page: 4

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH02	3.00	D	Wet Sieve	Brown slightly gravelly, sandy, silty CLAY



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
20	100		
14	100		
10	99		
6.3	97		
5	96		
3.35	96		
2	94		
1.18	93		
0.6	92		
0.425	88		
0.3	75		
0.212	58		
0.15	54		
0.063	51		

Dry Mass of sample, g
483

Sample Proportions	% dry mass
Very coarse	0
Gravel	6
Sand	44
Fines <0.063mm	51

Grading Analysis		
D100	mm	14
D60	mm	0.223
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

Site: Twycross 200

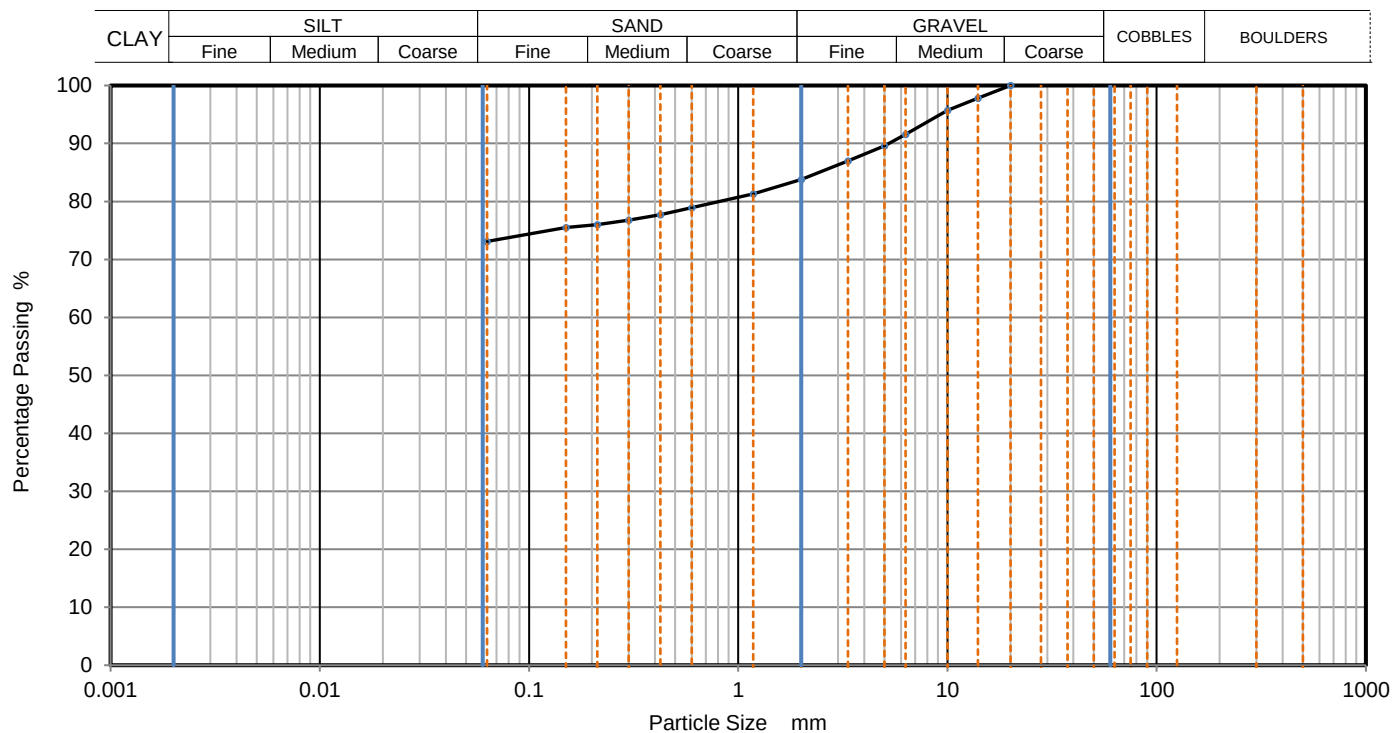
Job Number: 2281688

Client: Envirolab

Page: 5

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH03	5.00	D	Wet Sieve	Brown sandy, gravelly, silty CLAY



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
20	100		
14	98		
10	96		
6.3	92		
5	90		
3.35	87		
2	84		
1.18	81		
0.6	79		
0.425	78		
0.3	77		
0.212	76		
0.15	76		
0.063	73		

Dry Mass of sample, g
366

Sample Proportions	% dry mass
Very coarse	0
Gravel	16
Sand	11
Fines <0.063mm	73

Grading Analysis	
D100 mm	20
D60 mm	
D30 mm	
D10 mm	
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

Site: Twycross 200

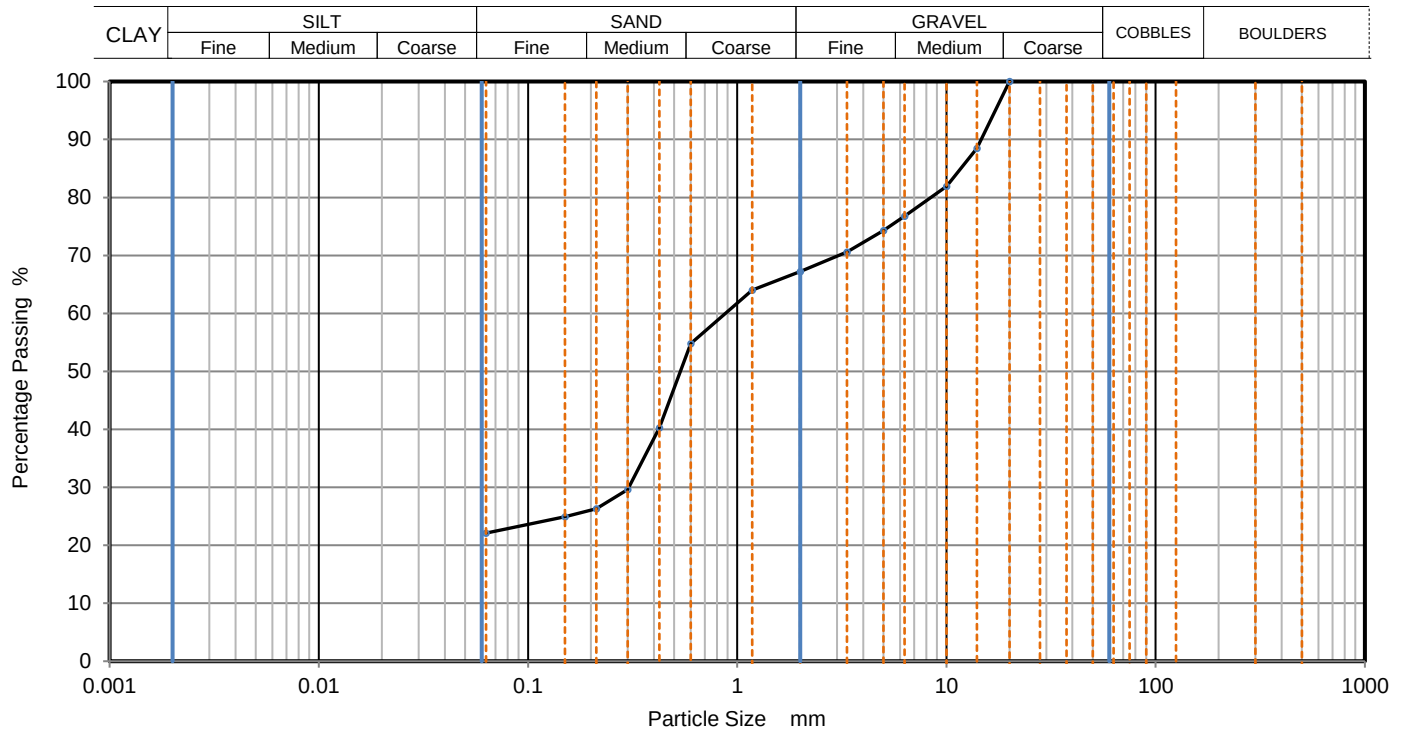
Job Number: 2281688

Client: Envirolab

Page: 6

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
BH04	2.00	D	Wet Sieve	Brown silty, clayey, gravelly SAND



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
20	100		
14	89		
10	82		
6.3	77		
5	74		
3.35	71		
2	67		
1.18	64		
0.6	55		
0.425	40		
0.3	30		
0.212	26		
0.15	25		
0.063	22		

Dry Mass of sample, g
425

Sample Proportions	% dry mass
Very coarse	0
Gravel	33
Sand	45
Fines <0.063mm	22

Grading Analysis		
D100	mm	20
D60	mm	0.879
D30	mm	0.304
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method

Site: Twycross 200

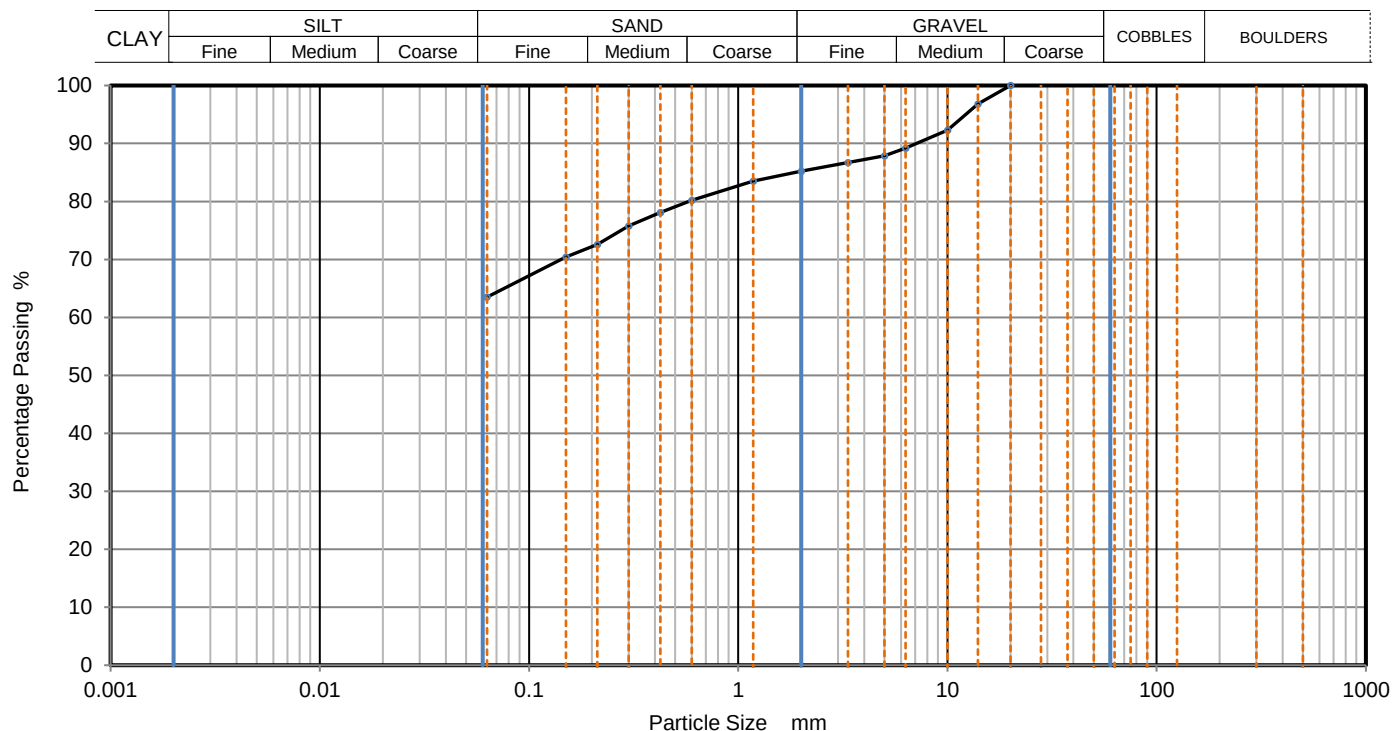
Job Number: 2281688

Client: Envirolab

Page: 7

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Testing Type	Description
WS05	4.00	D	Wet Sieve	Brown gravelly, sandy, silty CLAY



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
20	100		
14	97		
10	92		
6.3	89		
5	88		
3.35	87		
2	85		
1.18	84		
0.6	80		
0.425	78		
0.3	76		
0.212	73		
0.15	70		
0.063	64		

Dry Mass of sample, g
248

Sample Proportions	% dry mass
Very coarse	0
Gravel	15
Sand	22
Fines <0.063mm	64

Grading Analysis	
D100 mm	20
D60 mm	
D30 mm	
D10 mm	
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Method of Preparation: BS 1377:Part 1:1990, clause 7.3 Initial preparation
BS 1377:Part 1:1990, clause 7.4.5 Preparation of particle size tests

Method of Test: BS1377:Part 2:1990, clause 9.2 Determination of particle size distribution by wet sieving method



Final Test Report - 2281688 / 1

Site: Twycross 200

Job Number: 2281688

Originating Client: Envirolab

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

This test report shall not be reproduced, except in full and only with the written permission of Ian Farmer Associates Ltd.

Samples will be retained for 28 days from date of issue of the final test report before being disposed of, unless we receive written instruction to the contrary.

Report End

Report Issue Date: 10/10/2023



TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS
Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022,
cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022,
cl 5.2 and 6

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB



4041

Client: Clancy Consulting
Client Address: Dunham Court, 2 Dunham Road,
Altrincham

Contact: Sophie Piercy
Site Address: Twycross Zoo

Client Reference: 10 2197
Job Number: 24-043401-1
Date Sampled: 09/09/2004
Date Received: 19/09/2024
Date Tested: 27/09/2024
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

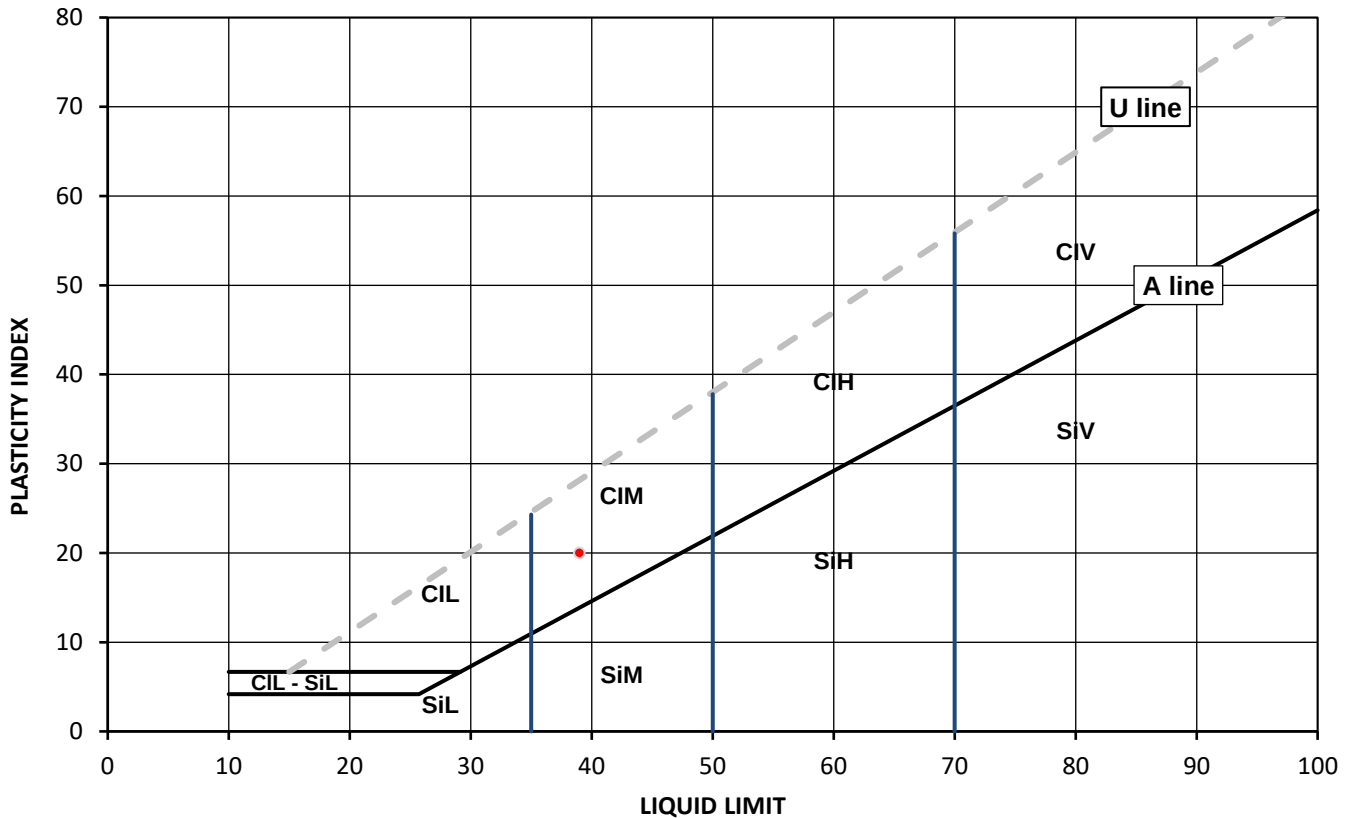
Test Results:

Laboratory Reference: 323665
Hole No.: WS01
Sample Reference: Not Given
Sample Description: Orangish brown slightly gravelly sandy CLAY

Depth Top [m]: 3.00
Depth Base [m]: Not Given
Sample Type: D

Sample Preparation: Tested after >0.425mm removed by hand; The water content in the sample was increased
Cone Type: 80g/30deg

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
24.6	39	19	20	0.30	0.70	99



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

	Plasticity	Liquid Limit
Cl	Clay	below 35
Si	Silt	35 to 50
	L	Low
	M	Medium
	H	High
	V	Very high
	O	Organic
		append to classification for organic material (eg ClHO)

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

Remarks:

Signed:

Katarzyna Koziel
Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.



TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS
Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022,
cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022,
cl 5.2 and 6

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB



4041

Client: Clancy Consulting
Client Address: Dunham Court, 2 Dunham Road,
Altrincham

Contact: Sophie Piercy
Site Address: Twycross Zoo

Client Reference: 10 2197
Job Number: 24-043401-1
Date Sampled: 09/09/2004
Date Received: 19/09/2024
Date Tested: 27/09/2024
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

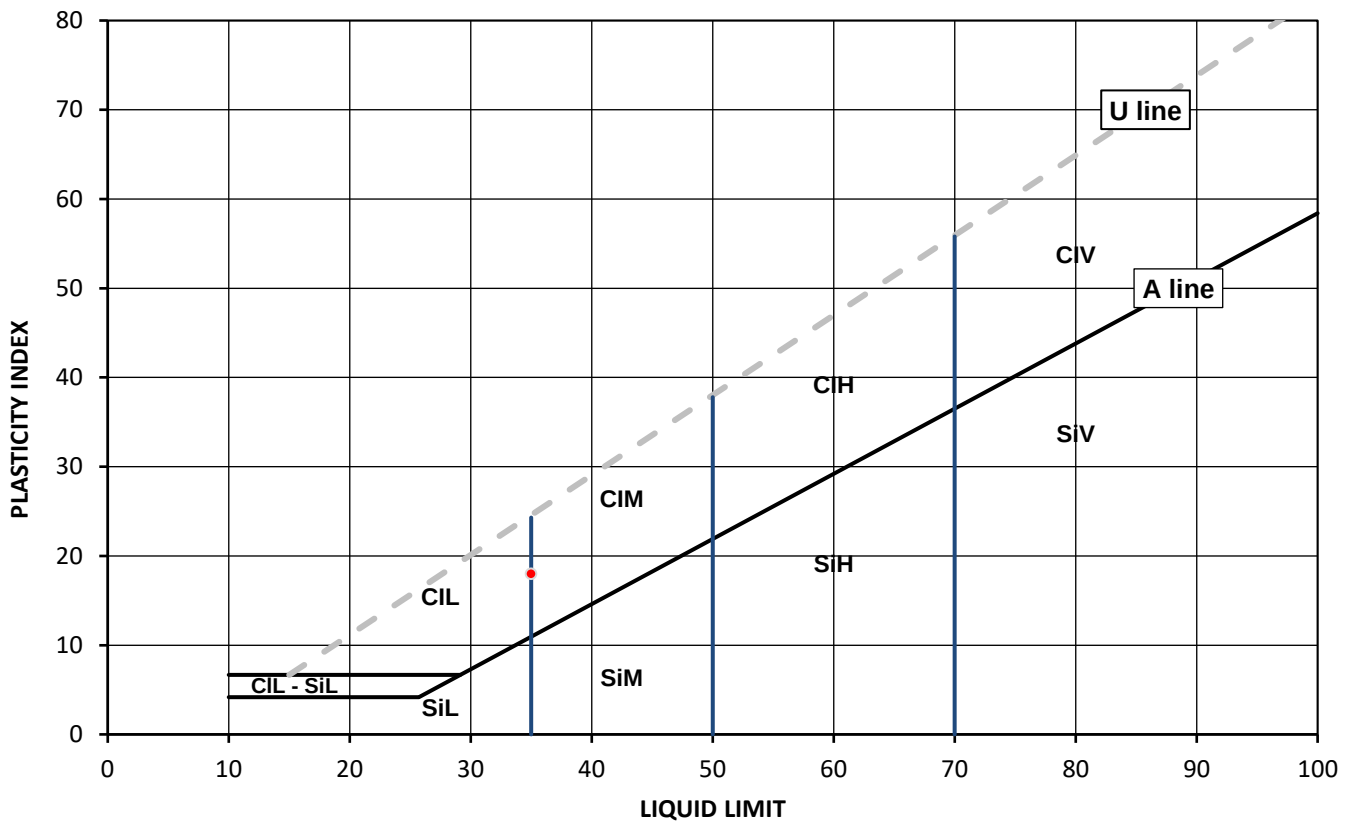
Test Results:

Laboratory Reference: 323666
Hole No.: WS04
Sample Reference: Not Given
Sample Description: Brownish grey slightly gravelly sandy CLAY

Depth Top [m]: 3.70
Depth Base [m]: Not Given
Sample Type: D

Sample Preparation: Tested after >0.425mm removed by hand; The water content in the sample was increased
Cone Type: 80g/30deg

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
23.6	35	17	18	0.39	0.61	95



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

	Plasticity	Liquid Limit
Cl	Clay	below 35
Si	Silt	35 to 50
	L	Low
	M	Medium
	H	High
	V	Very high
	O	Organic
		append to classification for organic material (eg ClHO)

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

Remarks:

Signed:

Katarzyna Koziel
Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

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SUMMARY REPORT

SUMMARY OF CLASSIFICATION TEST RESULTS

Tested in Accordance with:

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB



Environmental Science

4041

Client: Clancy Consulting

Client Address: Dunham Court, 2 Dunham Road,
Altrincham

Contact: Sophie Piercy

Site Address: Twycross Zoo

BS EN ISO 17892-12:2018+A2:2022 cl 5.3 and 5.5, Fall Cone Method, 4 Pt
Test, BS 1377-2:2022, cl 5.2 and 6. W by BS EN ISO 17892-1:2014+A1:2022.

Client Reference: 10 2197

Job Number: 24-043401-1

Date Sampled: 09/09/2004

Date Received: 19/09/2024

Date Tested: 27/09/2024

Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	W	Liquid & Plastic Limit							Density		
		Reference	Depth Top	Depth Base	Type				% Passing 425um	WL *	Correlation Factor	Wp	Ip	Cone type	Sample Preparation	bulk	dry	PD
			m	m														
323665	WS01	Not Given	3.00	Not Given	D	Orangish brown slightly gravelly sandy CLAY	Atterberg 4 Point	24.6	99	39	-	19	20	80g/30 deg	R / I			
323666	WS04	Not Given	3.70	Not Given	D	Brownish grey slightly gravelly sandy CLAY	Atterberg 4 Point	23.6	95	35	-	17	18	80g/30 deg	R / I			

Note: # Non accredited; NP - Non plastic; N - Tested in natural condition, R - Tested after >0,425mm removed by hand, WR - Tested after washing to remove >425mm; I - The water content in the sample was increased , D - The water content in the sample was decreased; * - One point liquid limit corrected as per the report Correlation Factor by Clayton C.R.I and Jukes A.W (1978)

Comments:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

Signed:

Katarzyna Koziel
Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd



SUMMARY REPORT
DETERMINATION OF WATER CONTENT

Tested in Accordance with: BS EN ISO 17892-1:2014+A1:2022, BS 1377-2: 2022, clause 4.1

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB



4041
Client: Clancy Consulting
Client Address: Dunham Court, 2 Dunham Road,
Altrincham

Contact: Sophie Piercy
Site Address: Twycross Zoo

Client Reference: 10 2197
Job Number: 24-043401-1
Date Sampled: 09/09/2004
Date Received: 19/09/2024
Date Tested: 27/09/2024
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	WC											
		Reference	Depth Top m	Depth Base m	Type														
323665	WS01	Not Given	3.00	Not Given	D	Orangish brown slightly gravelly sandy CLAY		24.6											
323666	WS04	Not Given	3.70	Not Given	D	Brownish grey slightly gravelly sandy CLAY		23.6											

Comments:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

Signed:

Katarzyna Koziel
Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd



4041



TEST CERTIFICATE

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Tested in Accordance with: BS EN ISO 17892-4:2016,
BS 1377-2:2022 cl. 10

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB



Client: Clancy Consulting
Client Address: Dunham Court, 2 Dunham Road,
Altrincham

Contact: Sophie Piercy
Site Address: Twycross Zoo

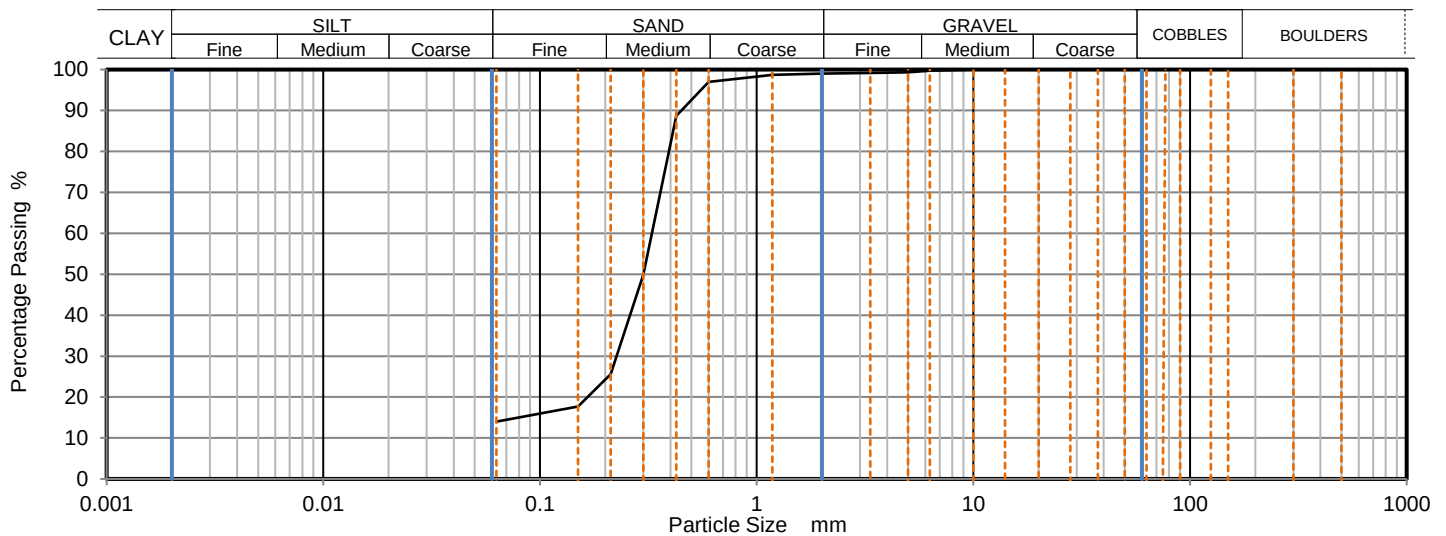
Client Reference: 10 2197
Job Number: 24-043401-1
Date Sampled: 09/09/2004
Date Received: 19/09/2024
Date Tested: 27/09/2024
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference: 323667
Hole No.: WS07
Sample Reference: Not Given
Sample Description: Brown clayey SAND
Sample Preparation: Sample was quartered, oven dried at 107.2 °C and broken down by hand.

Depth Top [m]: 5.00
Depth Base [m]: Not Given
Sample Type: D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	99		
3.35	99		
2	99		
1.18	99		
0.6	97		
0.425	89		
0.3	50		
0.212	26		
0.15	18		
0.063	14		

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	1.00
Sand	85.00
Fines <0.063 mm	14.00

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	5.2
Curvature Coefficient	

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with ISO 17892 -4, by sieving on as received or wet sample

Remarks:

Signed:

Katarzyna Koziel
Geotechnical Reporting Team Leader
for and on behalf of i2 Analytical Ltd

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APPENDIX V
GROUND GAS MONITORING RESULTS

MONITORING RESULTS

CLIENT: Twycross Zoo - East Midland Zoological Society **JOB NO:** 10/2197
SITE: Twycross Zoo **SHEET:** 1 of 6
DATE: 05/10/2023

Ambient Concentration (% Volume)			CH4		0.0		CO2		0.0			
			O2		24.3							
Monitoring Point			Gas Concentration								Gas Flow Rate	Remarks
			Highest		Steady			Lowest	H2S			
Ref	GWL	Depth	CH4		CO2	CH4		CO2		O2		
	(m)BGL	(m) BGL	% LEL	% v/v	(%)	% LEL	% v/v	(%)	(%)	ppm	l/hr	
BH01 - 1	0	15	0	0	0	0	0	0	0	0	0	Unable to open monitoring
BH02 - 1	12.73	15	0	0	0	0	0	0	13.8	0	1	
BH04 - 1	2	15	0	0	0	0	0	0	13.3	0	0	

Barometric Pressure (mb): 1007	Monitoring Equipment: GA94a Gas Analyser
Barometric Trend:	Date Of Last Calibration:
Weather: Rain	Operator: SHP
Ground Condition: Wet	

KEY	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	Unable to open BH01 monitoring point.

Checked:	Approved:
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MONITORING RESULTS



CLIENT: Twycross Zoo - East Midland Zoological Society **JOB NO:** 10/2197
SITE: Twycross Zoo **SHEET:** 2 of 6
DATE: 30/10/2023

Ambient Concentration (% Volume)			CH4		CO2							
			O2									
Monitoring Point			Gas Concentration								Gas Flow Rate	Remarks
			Highest		Steady		Lowest	H2S				
Ref	GWL	Depth	CH4		CO2	CH4			CO2	O2		
	(m)BGL	(m) BGL	% LEL	% v/v	(%)	% LEL	% v/v	(%)	(%)	ppm		
BH01 - 1	8.52	15	0	0	2	0	0	1.1	12.2	0	0	
BH02 - 1	13.5	15	0	0	0.8	0	0	0.6	4	0	0.2	

Barometric Pressure (mb): 976	Monitoring Equipment: GA94a Gas Analyser
Barometric Trend:	Date Of Last Calibration:
Weather: Overcast	Operator: SP
Ground Condition:	

KEY	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	

Checked:	Approved:
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MONITORING RESULTS



CLIENT: Twycross Zoo - East Midland Zoological Society **JOB NO:** 10/2197
SITE: Twycross Zoo **SHEET:** 3 of 6
DATE: 06/11/2023

Ambient Concentration (% Volume)												
			CH4			CO2						
			O2									
Monitoring Point			Gas Concentration								Gas Flow Rate	Remarks
			Highest		Steady		Lowest	H2S				
Ref	GWL	Depth	CH4		CO2	CH4			CO2	O2		
	(m)BGL	(m) BGL	% LEL	% v/v	(%)	% LEL	% v/v	(%)	(%)	ppm	l/hr	
BH01 - 1	7.93	15	0	0	2.4	0	0	0.8	12.8	0	0	
BH02 - 1	13.43	15	0	0	0.1	0	0	0	20.8	0	6.6	
BH04 - 1	0.81	15	0	0	0.8	0	0	0.3	20.4	0	0	

Barometric Pressure (mb): 1006 Barometric Trend: Weather: Sunny Ground Condition:	Monitoring Equipment: GA94a Gas Analyser Date Of Last Calibration: Operator: SP
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KEY	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	

Checked:	Approved:
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MONITORING RESULTS



CLIENT: Twycross Zoo - East Midland Zoological Society **JOB NO:** 10/2197
SITE: Twycross Zoo **SHEET:** 4 of 6
DATE: 21/11/2023

Ambient Concentration (% Volume)												
CH4					CO2							
O2												
Monitoring Point			Gas Concentration								Gas Flow Rate	Remarks
			Highest			Steady			Lowest	H2S		
Ref	GWL	Depth	CH4		CO2	CH4		CO2	O2			
	(m)BGL	(m) BGL	% LEL	% v/v	(%)	% LEL	% v/v	(%)	(%)	ppm	l/hr	
BH01 - 1	7.57	15	0	0	4	0	0	2.1	9.5	0	0	
BH02 - 1	13.27	15	0	0	0.6	0	0	0.4	18.2	0	-7	
BH04 - 1	1.01	15	0	0	0.8	0	0	0.8	15.5	0	0	

Barometric Pressure (mb): 1006 Barometric Trend: Weather: Rain Ground Condition:	Monitoring Equipment: GA94a Gas Analyser Date Of Last Calibration: Operator: SP
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KEY	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	

Checked:	Approved:
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MONITORING RESULTS



CLIENT: Twycross Zoo - East Midland Zoological Society **JOB NO:** 10/2197
SITE: Twycross Zoo **SHEET:** 5 of 6
DATE: 09/01/2024

Ambient Concentration (% Volume)			CH4		0.0		CO2		0.0			
			O2		20.8							
Monitoring Point			Gas Concentration								Gas Flow Rate	Remarks
			Highest			Steady			Lowest	H2S		
Ref	GWL	Depth										
	(m)BGL	(m) BGL	% LEL	% v/v	(%)	% LEL	% v/v	(%)	(%)	ppm	l/hr	
BH01 - 1	6.19	15	0	0	5.8	0	0	0.7	8.1	0	0	
BH02 - 1	10.51	15	0	0	0.7	0	0	0.2	4.3	0	8.5	
BH04 - 1	0.85	15	0	0	0.4	0	0	0.4	13.2	0	0	

Barometric Pressure (mb): 1016	Monitoring Equipment: GA94a Gas Analyser
Barometric Trend:	Date Of Last Calibration:
Weather: Sunny	Operator: SP
Ground Condition:	

KEY	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	

Checked:	Approved:
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MONITORING RESULTS



CLIENT: Twycross Zoo - East Midland Zoological Society **JOB NO:** 10/2197
SITE: Twycross Zoo **SHEET:** 6 of 6
DATE: 29/02/2024

Ambient Concentration (% Volume)			CH4		0.0		CO2		0.0			
			O2		19.8							
Monitoring Point			Gas Concentration								Gas Flow Rate	Remarks
			Highest			Steady			Lowest	H2S		
Ref	GWL	Depth										
	(m)BGL	(m) BGL	% LEL	% v/v	(%)	% LEL	% v/v	(%)	(%)	ppm	l/hr	
BH01 - 1	5.94	15	0	0	4.2	0	0	3	11.5	0	0	
BH02 - 1	10.32	15	0	0	0.8	0	0	0.7	3.6	0	9	
BH04 - 1	0.63	15	0	0	0.5	0	0	0.1	12.1	0	0	

Barometric Pressure (mb): 987	Monitoring Equipment: GA94a Gas Analyser Date Of Last Calibration: Operator: SP
Barometric Trend: falling	
Weather: Dry	
Ground Condition: Dry	

KEY	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	

Checked:	Approved:
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MONITORING RESULTS



CLIENT: Twycross Zoo - East Midland Zoological Society **JOB NO:** 10/2197
SITE: Twycross Zoo **SHEET:** 1 of 7
DATE: 10/5/2023

Ambient Concentration (% Volume)			CH4		0.0		CO2		0.0			
			O2		24.3							
Monitoring Point			Gas Concentration								Gas Flow Rate	Remarks
			Highest			Steady			Lowest	H2S		
Ref	GWL	Depth	CH4		CO2	CH4		CO2	O2			
	(m)BGL	(m) BGL	% LEL	% v/v	(%)	% LEL	% v/v	(%)	(%)	ppm	l/hr	
BH01 - 1	0	15	0	0	0	0	0	0	0	0	0	Unable to open
BH02 - 1	12.73	15	0	0	0	0	0	0	13.8	0	1	
BH04 - 1	2	15	0	0	0	0	0	0	13.3	0	0	

Barometric Pressure (mb): 1007 Barometric Trend: Weather: Rain Ground Condition: Wet	Monitoring Equipment: GA94a Gas Analyser Date Of Last Calibration: Operator: SHP
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KEY	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	Unable to open BH01 monitoring point.

Checked:	Approved:
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MONITORING RESULTS



CLIENT: Twycross Zoo - East Midland Zoological Society **JOB NO:** 10/2197
SITE: Twycross Zoo **SHEET:** 2 of 7
DATE: 10/30/2023

Ambient Concentration (% Volume)												
CH4					CO2							
O2												
Monitoring Point			Gas Concentration								Gas Flow Rate	Remarks
			Highest		Steady		Lowest	H2S				
Ref	GWL	Depth	CH4		CO2	CH4			CO2	O2		
	(m)BGL	(m) BGL	% LEL	% v/v	(%)	% LEL	% v/v	(%)	(%)	ppm	l/hr	
BH01 - 1	8.52	15	0	0	2	0	0	1.1	12.2	0	0	
BH02 - 1	13.5	15	0	0	0.8	0	0	0.6	4	0	0.2	

Barometric Pressure (mb): 976 Barometric Trend: Weather: Overcast Ground Condition:	Monitoring Equipment: GA94a Gas Analyser Date Of Last Calibration: Operator: SP
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KEY	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	

Checked:	Approved:
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MONITORING RESULTS

CLIENT: Twycross Zoo - East Midland Zoological Society **JOB NO:** 10/2197
SITE: Twycross Zoo **SHEET:** 3 of 7
DATE: 11/6/2023

Ambient Concentration (% Volume)												
CH4					CO2							
O2												
Monitoring Point			Gas Concentration								Gas Flow Rate	Remarks
			Highest		Steady		Lowest	H2S				
Ref	GWL	Depth	CH4		CO2	CH4			CO2	O2		
	(m)BGL	(m) BGL	% LEL	% v/v	(%)	% LEL	% v/v	(%)	(%)	ppm	l/hr	
BH01 - 1	7.93	15	0	0	2.4	0	0	0.8	12.8	0	0	
BH02 - 1	13.43	15	0	0	0.1	0	0	0	20.8	0	6.6	
BH04 - 1	0.81	15	0	0	0.8	0	0	0.3	20.4	0	0	

Barometric Pressure (mb): 1006 Barometric Trend: Weather: Sunny Ground Condition:	Monitoring Equipment: GA94a Gas Analyser Date Of Last Calibration: Operator: SP
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KEY	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	

Checked:	Approved:
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MONITORING RESULTS



CLIENT: Twycross Zoo - East Midland Zoological Society **JOB NO:** 10/2197
SITE: Twycross Zoo **SHEET:** 4 of 7
DATE: 11/21/2023

Ambient Concentration (% Volume)												
CH4					CO2							
O2												
Monitoring Point			Gas Concentration								Gas Flow Rate	Remarks
			Highest				Steady		Lowest	H2S		
Ref	GWL	Depth	CH4		CO2	CH4		CO2	O2			
	(m)BGL	(m) BGL	% LEL	% v/v	(%)	% LEL	% v/v	(%)	(%)	ppm	l/hr	
BH01 - 1	7.57	15	0	0	4	0	0	2.1	9.5	0	0	
BH02 - 1	13.27	15	0	0	0.6	0	0	0.4	18.2	0	-7	
BH04 - 1	1.01	15	0	0	0.8	0	0	0.8	15.5	0	0	

Barometric Pressure (mb): 1006 Barometric Trend: Weather: Rain Ground Condition:	Monitoring Equipment: GA94a Gas Analyser Date Of Last Calibration: Operator: SP
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KEY	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	

Checked:	Approved:
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MONITORING RESULTS

CLIENT: Twycross Zoo - East Midland Zoological Society **JOB NO:** 10/2197
SITE: Twycross Zoo **SHEET:** 5 of 7
DATE: 1/9/2024

Ambient Concentration (% Volume)			CH4		0.0		CO2		0.0			
			O2		20.8							
Monitoring Point			Gas Concentration								Gas Flow Rate	Remarks
			Highest			Steady			Lowest	H2S		
Ref	GWL	Depth									CH4	
	(m)BGL	(m) BGL	% LEL	% v/v	(%)	% LEL	% v/v	(%)	(%)	ppm	l/hr	
BH01 - 1	6.19	15	0	0	5.8	0	0	0.7	8.1	0	0	
BH02 - 1	10.51	15	0	0	0.7	0	0	0.2	4.3	0	8.5	
BH04 - 1	0.85	15	0	0	0.4	0	0	0.4	13.2	0	0	

Barometric Pressure (mb): 1016	Monitoring Equipment: GA94a Gas Analyser
Barometric Trend:	Date Of Last Calibration:
Weather: Sunny	Operator: SP
Ground Condition:	

KEY	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	

Checked:	Approved:
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MONITORING RESULTS



CLIENT: Twycross Zoo - East Midland Zoological Society **JOB NO:** 10/2197
SITE: Twycross Zoo **SHEET:** 6 of 7
DATE: 2/29/2024

Ambient Concentration (% Volume)			CH4		0.0		CO2		0.0			
			O2		19.8							
Monitoring Point			Gas Concentration								Gas Flow Rate	Remarks
			Highest			Steady			Lowest	H2S		
Ref	GWL	Depth	CH4		CO2	CH4		CO2	O2			
	(m)BGL	(m) BGL	% LEL	% v/v	(%)	% LEL	% v/v	(%)	(%)	ppm	l/hr	
BH01 - 1	5.94	15	0	0	4.2	0	0	3	11.5	0	0	
BH02 - 1	10.32	15	0	0	0.8	0	0	0.7	3.6	0	9	
BH04 - 1	0.63	15	0	0	0.5	0	0	0.1	12.1	0	0	

Barometric Pressure (mb): 987	Monitoring Equipment: GA94a Gas Analyser Date Of Last Calibration: Operator: SP
Barometric Trend: falling	
Weather: Dry	
Ground Condition: Dry	

KEY	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	

Checked:	Approved:
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MONITORING RESULTS

CLIENT: Twycross Zoo - East Midland Zoological Society **JOB NO:** 10/2197
SITE: Twycross Zoo **SHEET:** 7 of 7
DATE: 10/11/2024

Ambient Concentration (% Volume)			CH4				CO2				O2	
Monitoring Point			Gas Concentration								Gas Flow Rate	Remarks
			Highest		Steady		Lowest	H2S				
Ref	GWL	Depth							CH4		CO2	
	(m)BGL	(m) BGL	% LEL	% v/v	(%)	% LEL	% v/v	(%)	(%)	ppm	l/hr	
WS01 - 1	0.18	1.4	0	0	2.5	0	0	2.5	17.6	0	2.2	
WS04 - 1	0.95	3.7	0	0	2.1	0	0	2.1	17.6	0	0	
WS07 - 1	1.57	3.7	0	0.1	11.2	0	0.1	11.2	0	0	-2.6	

Barometric Pressure (mb): 998	Monitoring Equipment: GA94a Gas Analyser
Barometric Trend:	Date Of Last Calibration:
Weather: Overcast	Operator:
Ground Condition:	

KEY	Remarks
ND - None Detected NR - Not Recorded POS - Positive Flow NEG - Negative Flow	

Checked:	Approved:
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